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# U.S. Department of Energy Workshop

## Surveying the Milestones for Meeting the Challenges of the Nation's Growing Natural Gas Demand

March 5-6, 2001

The Madison Hotel, 15th and M Street, N.W., Washington, D.C.

### Meeting Agenda

#### March 5, 2001

- 1:00 p.m. Welcome and Overview—Robert Kripowicz, Paul Kelly
- Introductions
  - Purpose of Workshop
  - Findings and Recommendations of the National Petroleum Council's 1999 Study
  - Public Policy Context
- 1:40 p.m. Agenda Review, Workshop Roadmap and Overview—Nancy Johnson, Vello Kuuskraa
- 2:00 p.m. Demand Review and Discussion—Matthew Simmons, James Kendell, Harry Vidas
- 3:00 p.m. Break
- 3:20 p.m. Supply Review and Discussion—Thomas Nusz, Guido DeHoratiis, Vello Kuuskraa, Jeffrey Eppink
- 4:20 p.m. Transmission and Distribution Review and Discussion—Blaise Poole, Harry Vidas, Kevin Petak
- 5:30 p.m. Adjourn

#### March 6, 2001

- 9:00 a.m. Summary of Day One and What's Ahead—Robert Kripowicz, Paul Kelly
- 9:15 a.m. Stepping Back and Assessing the Market and Industry Situation — Paul Kelly, Vello Kuuskraa, James Kendell
- Overall Significance of Changes
  - Progress on Critical Issues
  - Implications for 1999 Study Results, Findings and Recommendations
  - Issues Warranting Continued or New Attention
- 10:30 a.m. Break
- 10:45 a.m. Next Steps for Industry and Government — Robert Kripowicz, Paul Kelly
- Workshop Proceedings
  - Other
- 12:00 p.m. Adjourn

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# U.S. Department of Energy Workshop

## Surveying the Milestones for Meeting the Challenges of the Nation's Growing Natural Gas Demand

March 5-6, 2001

The Madison Hotel, Washington, D.C.

### Workshop Attendees

#### Workshop Chairs

Robert S. Kripowicz,\* Acting Assistant Secretary for Fossil Energy, U.S. Department of Energy

Paul L. Kelly,\* Senior Vice President, Rowan Companies, Inc.

#### Industry Attendees

Nancy Bagot, Manager, Government Affairs, Enron Corporation

Thomas A. Fry,\* III, President, National Ocean Industries Association

Lee Fuller, Vice President, Government Relations, Independent Petroleum Association of America

Wayne Gibbens, President, U.S. Oil and Gas Association

Edward J. Gilliard,\* Senior Advisor, Planning and Acquisitions, Burlington Resources, Inc.

John H. Guy, IV,\* Deputy Executive Director, National Petroleum Council

James W. Hail, Jr.,\* Executive Vice President, DeGolyer and MacNaughton

Patricia A. Hammick,\* Retired Senior Vice President, Columbia Energy Group

George C. Hass,\* Executive Director, Business Development, CMS Gas Enterprises

John S. Hull,\* Director, Energy Market Analysis, Texaco Natural Gas

Hunter L. Hunt, President, Hunt Power, L.P.

Mark H. LaCroix,\* Reservoir Engineering Manager, Prize Energy Corporation

Gregg Nady, Manager, New Business Development, Shell E&P Company

Marshall W. Nichols,\* Executive Director, National Petroleum Council

John W. B. Northington,\* Vice President, National Environmental Strategies, Inc.

Thomas B. Nusz,\* Vice President, Acquisitions, Burlington Resources, Inc.

Blaise N. Poole,\* Manager, Marketing and Strategy, El Paso Gas Services Company

Ed Porter, Research Manager, American Petroleum Institute

Rhone Resch, Director of Utility Regulations and Environmental Affairs, Natural Gas Supply Association

Nora Scheller, Washington Representative, ExxonMobil

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Richard J. Sharples, President, Anadarko Energy Services Company  
Matthew R. Simmons,\* President, Simmons and Company International  
Walter (Skip) M. Simmons,\* Director of Gas, Mirant  
Neal Stanley, Senior Vice President, Forest Oil Corporation  
David Sweet, Vice President, Natural Gas, Independent Petroleum Association of America  
Diemer True, Partner, True Companies  
Michael G. Webb,\* Senior Vice President, Strategic Planning/Business Development, Kerr-McGee Corp.  
George Williams, Governmental Affairs Manager, Semptra Energy  
Paul Wilkinson,\* Vice President, Policy Analysis, American Gas Association  
John C. Wolfmeyer,\* Consulting Engineer, Science and Technology Planning, Duke Energy  
Byron S. Wright, Vice President, Strategy, El Paso Corporation  
Gregory W. Zwick,\* Director, Business Strategy, TransCanada PipeLines

**Government Attendees**

Elizabeth E. Campbell, Director, Natural Gas Division, Data Analysis & Forecasting Branch, Energy Information Administration, U.S. Department of Energy  
Walter D. Cruickshank,\* Associate Director, Policy and Management Improvement, Minerals Management Service, U.S. Department of the Interior  
Guido DeHoratiis,\* Acting Deputy Assistant Secretary, Office of Natural Gas and Petroleum Technology, U.S. Department of Energy  
Arthur M. Hartstein, Program Manager, Oil and Gas Processing, Office of Natural Gas and Petroleum Technology, U.S. Department of Energy  
Nina Rose Hatfield, Acting Director, Bureau of Land Management, U.S. Department of the Interior  
Erick V. Kaarlela,\* Senior Policy Advisor to the Assistant Director, Minerals, Realty and Resource Protection, Division of Fluid Minerals, Bureau of Land Management, U.S. Department of the Interior  
James M. Kendell,\* Director, Oil and Gas Division, Office of Integrated Analysis and Forecasting, Energy Information Administration, U.S. Department of Energy  
Thomas R. Kitsos, Acting Director, Minerals Management Service, U.S. Department of the Interior  
Bruce Ramsey, Associate Director, U.S. Forest Service  
Pulak Ray,\* Chief Geologist, Minerals Management Service, U.S. Department of the Interior

**Special Assistants**

David Costello, Energy Information Administration, U.S. Department of Energy  
Nancy L. Johnson, Director, Planning and Environmental Analysis, Office of Fossil Energy, U.S. Department of Energy

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Elena Subia Melchert, Program Manager, Office of Natural Gas and Petroleum Technology,  
U.S. Department of Energy

John J. Pyrdol,\* Senior Economist, Office of Natural Gas and Petroleum Technology,  
U.S. Department of Energy

Trudy Transtrum, Communications, Office of Natural Gas and Petroleum Technology,  
U.S. Department of Energy

William Trapmann, Economist, Energy Information Administration, U.S. Department of Energy

Feridun Albayrak, Vice President, Technology & Management Services, Inc.

Jeffrey Eppink,\* Vice President, Advanced Resources International, Inc.

Vello A. Kuuskraa,\* President, Advanced Resources International, Inc.

Kevin Petak,\* Director, Energy Modeling and Analysis, Energy and Environmental Analysis, Inc.

E. Harry Vidas,\* Managing Director, Energy and Environmental Analysis, Inc.

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\* Indicates participation in the 1999 NPC Natural Gas Study.



## Department of Energy

Washington, DC 20585

SAMPLE

Dear Colleague:

The purpose of this letter is to invite you to attend a Department of Energy Office of Fossil Energy workshop on Surveying the Milestones for Meeting the Challenges of the Nation's Growing Natural Gas Demand. The workshop will be held in Washington, D.C. on March 5 and 6, 2001, convening the first day from 1:00 p.m. to 5:30 p.m. and the second day from 9:00 a.m. to 12 noon. Joining me as co-chair of the workshop will be Paul L. Kelly, Senior Vice President, Rowan Companies, Inc.

In December 1999, the National Petroleum Council presented a report to the Secretary of Energy with findings and recommendations for Meeting the Challenges of the Nation's Growing Natural Gas Demand. The report highlighted the potential contribution of natural gas to meeting the Nation's future economic, energy and environmental objectives, as well as critical factors that must be addressed by industry and government to realize the full potential for natural gas use in the United States. The Council's landmark report was distributed widely and has done much to raise awareness of natural gas issues among industry and government decision makers. However, the Nation's energy needs and industry's ability to address these needs are dynamic and will change over time. Accordingly, the Council recommended that government should periodically monitor trends in the assumptions used by the Council and progress on the critical factors in order to anticipate changes in supply and demand. In view of current energy projections, recent changes in natural gas prices and drilling activity, and growth in natural gas demand for electricity generation, it is clear that a review of the report would be useful.

Our aim in conducting this workshop is to offer an opportunity for industry and government executives, especially those individuals who participated in the conduct of the Council's 1999 study, to discuss and share their individual observations about: 1) the assumptions used in the 1999 study, 2) changes in natural gas market conditions and public policies since then, 3) the magnitude of these changes (e.g., as compared to prior modeling results or sensitivity analyses), and 4) what implications these changes may have for the results, findings and recommendations of the Council's 1999 study. While we are not seeking consensus views, we trust these observations can inform industry and government decision makers in understanding our Nation's energy situation and the role of natural gas in meeting the future energy needs of consumers.

To confirm your availability, or if you have questions regarding the workshop, please contact Nancy Johnson, Director of Planning and Environmental Analysis (202-586-6458), or Trudy Transtrum (202-586-7253) with the Office of Fossil Energy. You may also contact Marshall Nichols or John Guy of the National Petroleum Council staff who have kindly assisted us in planning this event. Additional workshop details will be sent to you as soon as they are finalized. I look forward to a comprehensive and enlightening discussion.

Sincerely,

Robert S. Kripowicz  
Acting Assistant  
Secretary for Fossil Energy

Enclosure



**The Secretary of Energy**

Washington, DC 20585

May 6, 1998

Mr. Joe B. Foster  
Chair  
National Petroleum Council  
1625 K Street, N.W.  
Washington, D.C. 20006

Dear Mr. Foster:

In 1992, the National Petroleum Council released a study entitled, "Potential of Natural Gas in the United States." That study was critical in identifying natural gas as an abundant domestic resource that can make a significantly larger contribution to both this Nation's energy supply and its environmental goals.

Since the release of the study, the Nation has experienced five years of sustained growth in the use of natural gas. In addition, the study did not anticipate at least two major forces that are beginning to take shape, which will profoundly affect energy choices in the future -- the restructuring of electricity markets and growing concerns about the potentially adverse consequences that using higher carbon-content fuels may have on global climate change and regional air quality. These issues offer opportunities and challenges for our Nation's natural gas supply and delivery system. For a secure energy future, Government and private sector decision makers need to be confident that industry has the capability to meet potentially significant increases in future natural gas demand.

Accordingly, I am requesting that the Council reassess its 1992 study taking into account the past five years' experience and evolving market conditions that will affect the potential for natural gas in the United States to 2020 and beyond. Of particular interest is the Council's advice on areas of Government policy and action that would enable natural gas to realize its potential contribution toward our shared economic, energy, and environmental goals.

Given the significance of this request, Deputy Secretary Elizabeth Moler will co-chair the study committee. I offer my gratitude to the Council for its efforts since our meeting in December 1997, to assist the Department in defining a more concise study scope. The breadth of issues related to natural gas supply and demand is vast and I recognize that further refinements in scope may be necessary once the study is underway to address the most significant concerns about future natural gas availability.

Sincerely,

A handwritten signature in black ink, which appears to read "Federico Peña".

Federico Peña



**The Secretary of Energy**

Washington, DC 20585

November 18, 1998

Mr. Joe B. Foster  
Chair  
National Petroleum Council  
1625 K Street, N.W.  
Washington, D.C. 20006

Dear Mr. Foster:

This is to convey my approval to establish a Committee on Natural Gas and to appoint industry members as proposed in your letter of October 6, 1998. I also approve the establishment of a coordinating subcommittee and the appointment of subcommittee members identified in your letter.

The Deputy Secretary will serve as the Government co-chair of the committee; the Assistant Secretary for Fossil Energy will co-chair the coordinating subcommittee. Staff involved in this study will be from the Office of Fossil Energy and the Office of Policy and International Affairs. In addition, the Energy Information Administration has expressed an interest in providing technical and analytic support. The Deputy Assistant Secretary for Natural Gas and Petroleum Technology will serve as the alternate for the Government co-chair of the subcommittee.

I agree that it would be appropriate for a representative of the Department of the Interior to be a member of the coordinating subcommittee, and we are pursuing this issue.

For a secure energy future, Government and private sector decision-makers need to be confident that industry has the capability to meet the significant increases in natural gas demand forecasted for the twenty-first century. I am pleased that the National Petroleum Council recognizes the challenge facing the domestic natural gas industry and has agreed to conduct a study of natural gas supply availability. I look forward to the study's results.

Yours sincerely,

A handwritten signature in black ink, reading "Bill Richardson", is positioned above the printed name.

Bill Richardson

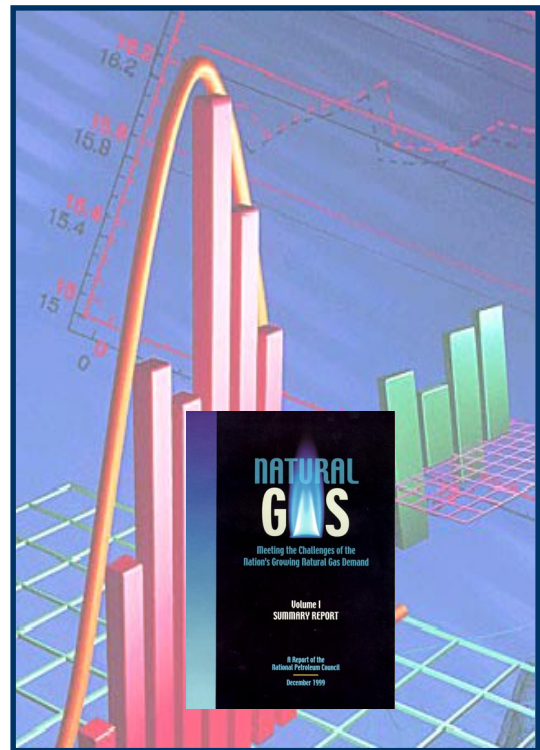


# U.S. Department of Energy Workshop

## Surveying the Milestones for Meeting the Challenges of the Nation's Growing Natural Gas Demand

March 5-6, 2001  
Washington, DC

- NPC Natural Gas Study Assumptions Roadmap
- Demand
- Supply
- Transmission & Distribution



## Meeting the Challenges of the Nation's Growing Natural Gas Demand

NATIONAL PETROLEUM COUNCIL

NPC

## KEY MODEL ASSUMPTIONS

U.S. GDP Growth	2.5% per year
Canadian GDP Growth	2.2% per year
U.S. Industrial Production	3.0% per year
U.S. Inflation Rate	2.5% per year
Crude Oil Price (WTI)	\$18.50/BBL in 1999 \$
Crude Oil Price (RACC*)	\$16.50/BBL in 1999 \$

\* Refiners' Average Cost of Crude in the United States

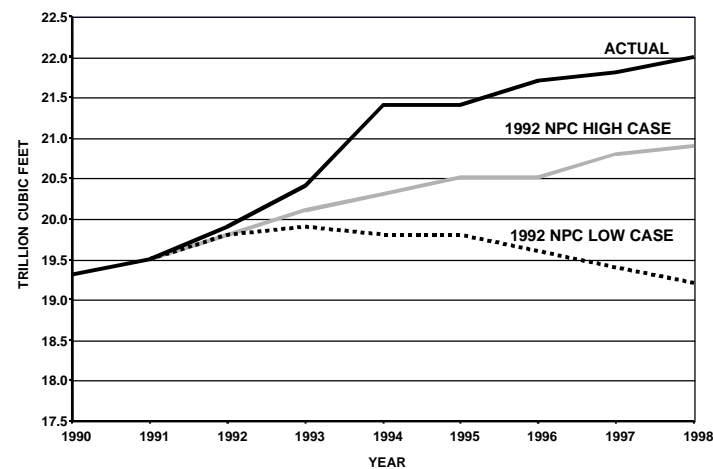
NPC

## DEMAND KEY FINDINGS

- Finding #1: Rapid Growth Exceeded Expectations of the 1992 Study
- Finding #2: Demand Will Increase by 32% between 1998 and 2010
- Finding #3: Environmental Regulations Could Add Significant Incremental Demand

NPC

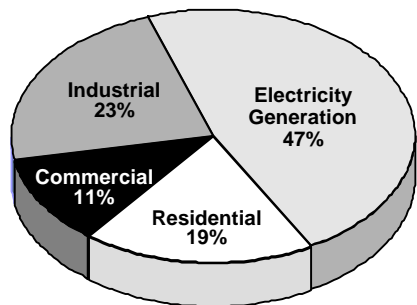
## U.S. Natural Gas Demand, 1990-1998



NPC

### Growth in Reference Case Demand 1998-2010

Distribution of 7 TCF Increase by Sector



NPC

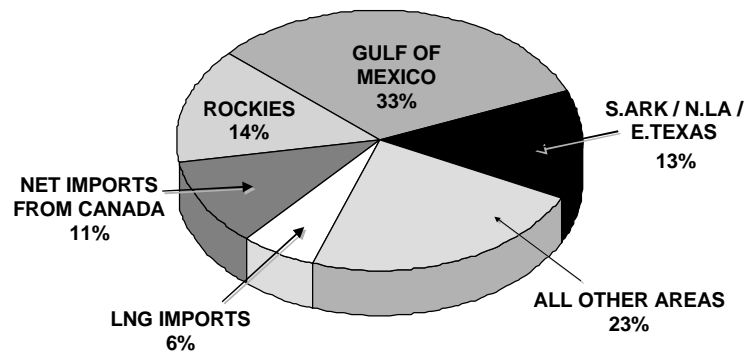
### SUPPLY KEY FINDINGS

- Finding #1: Sufficient Resources Exist to Meet Growing Demand
- Finding #2: A Healthy Oil & Gas Industry Is Critical
- Finding #3: Investment in Research and Development Is Needed
- Finding #4: Restricted Access Will Limit the Availability of Supply

NPC

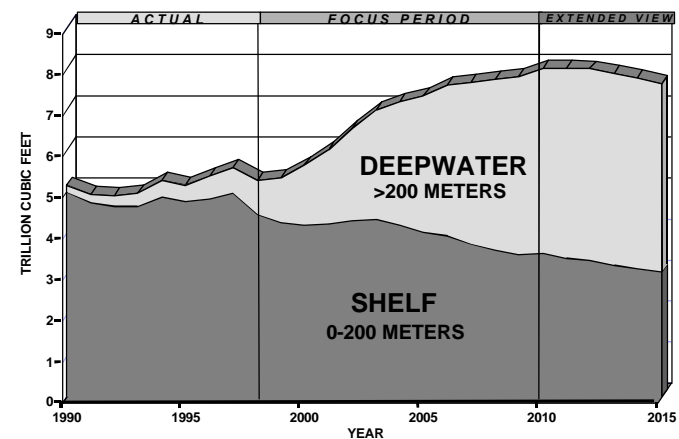
### Growth in Reference Case Supply 1998-2010

Distribution of 7 TCF Increase by Source



NPC

### U.S. Gulf of Mexico Natural Gas Production



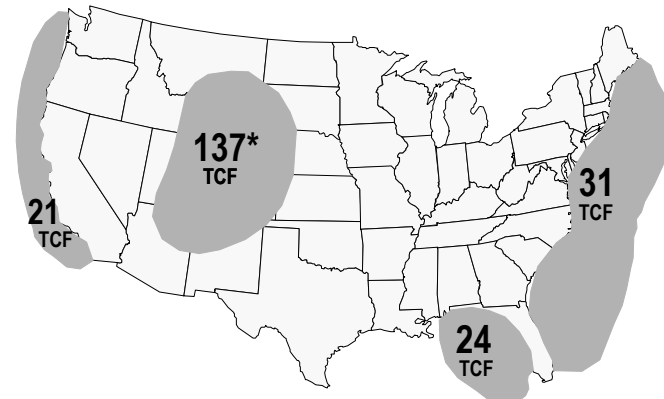
NPC

## NEW SUPPLY WILL COME FROM

- Deeper Wells
- More Non-Conventional Sources
- Deeper Water

NPC

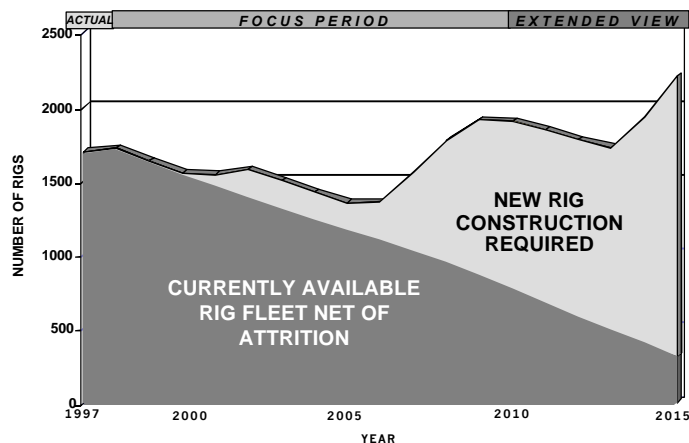
## U.S. Lower-48 Natural Gas Resources Subject to Access Restrictions



\* Approximately 29 Tcf of the Rockies gas resources are closed to development and 108 Tcf are available with restrictions.

NPC

## Onshore Drilling Rig Fleet, 1997–2015



NPC

## RECENT TRENDS IN TECHNOLOGY DEVELOPMENT

- Industry Consortia for Technology Development Have Been Cost-Effective
- Technology Development Has Shifted from the Majors to the Service Companies
- Investment In Research and Development Down Due to Consolidations and Cutbacks
- Funding for Basic Research Appears To Be Lagging

NPC

## **TRANSMISSION AND DISTRIBUTION KEY FINDINGS**

- **Finding #1: Delivery System Requires Significant Expansion and Enhancements**
- **Finding #2: Access Issues Impede Installation of New Infrastructure**
- **Finding #3: New Services Are Needed for the Changing Market**
- **Finding #4: Risk Assumption for Pipeline Expansions Is in Question**

NPC

## **MARKET CHANGES**

- **Restructuring Changes the Roles of Market Participants**
  - LDCs / Electric Utilities / Marketers / Energy Service Providers / Producers / Electricity Generators
- **Operational Aspects of Gas-Fired Electricity Generation Drive Need for New Services**
  - High Minimum Inlet Pressures for Gas-Fired Turbines
  - Swing Capabilities Due to Load-Following Requirement
  - Hourly Scheduling / Nominations

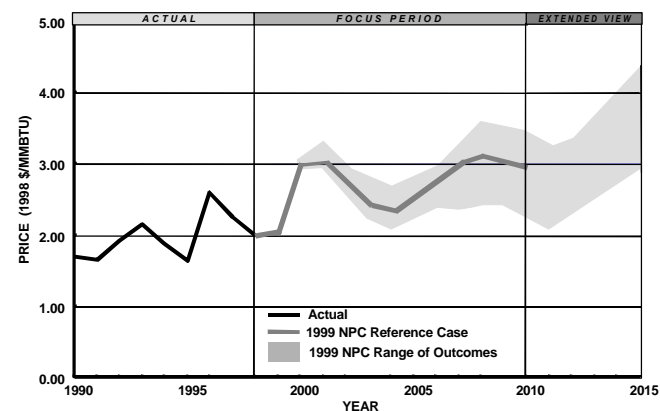
NPC

## **CRITICAL FACTORS**

- **Access**
- **Technology**
- **Financial Requirements**
- **Skilled Workers**
- **Rigs**
- **Lead Times**
- **Requirements of New Customers**

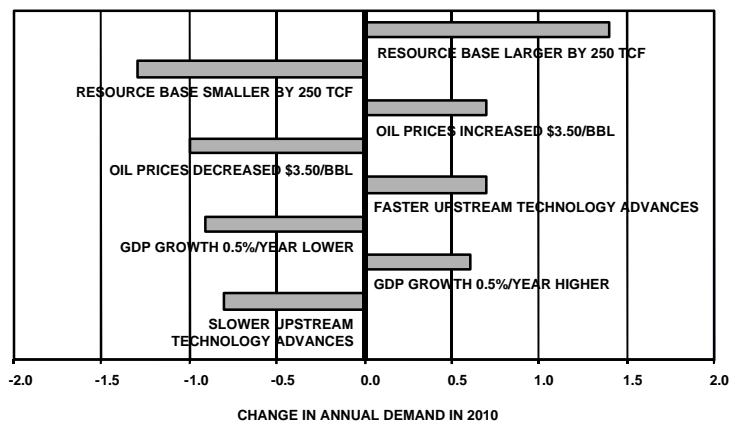
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## **Historical and Projected U.S. Natural Gas Prices**



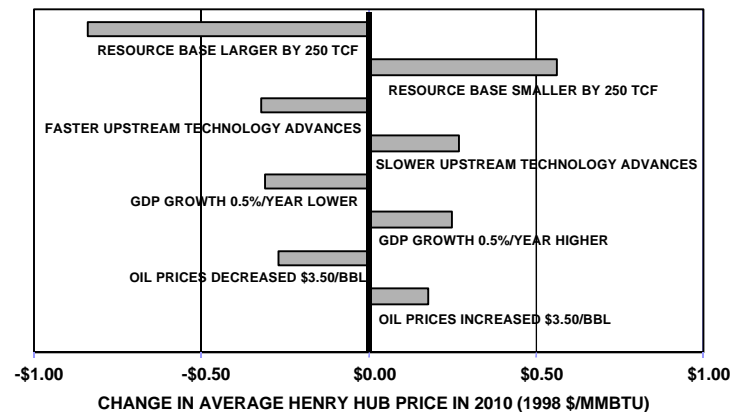
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### Influence of Key Assumptions on Natural Gas Demand



NPC

### Influence of Key Assumptions on Natural Gas Price



NPC

### RECOMMENDATION #1

- Establish a Strategy – at the Highest Level – for Natural Gas in the Nation's Energy Portfolio
- Form an Interagency Work Group under the National Economic Council

NPC

### RECOMMENDATION #2

- Establish a Balanced, Long-term Approach for Responsibly Developing the Nation's Resource Base
  - Assess Impact of Existing Restrictions
  - Prioritize Restricted Areas
  - Develop Supply in Selected Areas
  - Plan for Long-Term Sustainability

NPC

### **RECOMMENDATION #3**

- **Drive Research and Technology Development at a Rapid Rate**
  - Invest in Research
  - Support Additional Industry Consortia
  - Promote High-Efficiency Gas Technology

NPC

### **RECOMMENDATION #4**

- **Plan for Capital, Infrastructure, and Human Resource Needs**
  - Examine New Financial Incentives
  - Form a Joint Industry Task Force on Drilling
  - Develop Workforce Plan

NPC

- **RECOMMENDATION #5**  
Streamline Processes that Impact Gas Development
- **RECOMMENDATION #6**  
Assess the Impact of Environmental Regulation on Natural Gas Demand and Supply
- **RECOMMENDATION #7**  
Design New Services to Meet Changing Customer Needs

NPC

## **SURVEYING THE MILESTONES**

IN THE

### **NPC 1999 Study**

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*Prepared By:*

Vello A. Kuuskraa  
ADVANCED RESOURCES INTERNATIONAL, INC.

*For:*

U.S. DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY WORKSHOP  
WASHINGTON, DC  
MARCH 5 - 6, 2001

### **Background and Purpose**

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The 1999 National Petroleum Council (NPC) study, entitled “Meeting the Challenges of the Nation’s Growing Natural Gas Demand”, was prepared to provide the Secretary of Energy with forward looking advice and a roadmap for action on natural gas.

In delivering the report, the NPC stated its interest in maintaining the “evergreen” nature of the roadmap and recommended that certain trends in the natural gas industry “should be actively monitored as early warning indicators.”

### **Background and Purpose (cont.)**

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The purpose of this “survey of the milestones” is to record the performance of the natural gas industry during the past two years and, more importantly, to gain an updated perspective on the critical trends of importance to the industry.

Particular attention will be given to the topics and issues that may require action by government, industry and other stakeholders to ensure reliable, competitively priced natural gas.

### **1. Domestic Natural Resource Base Is Bountiful.**

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It is important to highlight that the recent natural gas market issues do not stem from a lack of underlying natural gas resources. As stated in the NPC 1999 Study, the U.S. has a large, rich and diverse natural gas resource base.

Each time industry or resource appraisers have examined the natural gas resource base, they have judged it to be larger.



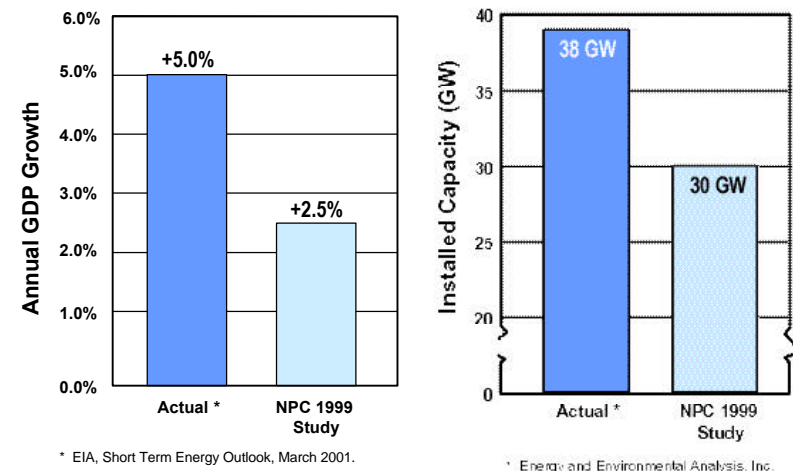
## 2. Demand For Natural Gas Has Grown Faster Than Anticipated.

Natural gas demand has grown by 1.8 Tcf from 1998 to 2000, 0.5 Tcf higher than projected in the NPC 1999 Study.

Faster economic growth, increased demand for natural gas-fired electricity, lower hydropower and a colder than normal winter account for the increased demand.

- *Is the higher-than-2.5% annual GDP growth (in '99 & '00) a longer term trend? How does this affect energy consumption?*
- *How much additional gas-fired electric power capacity will be installed in the next two years? How will this capacity be dispatched?*

Figure 1.  
Factors Behind Increased Natural Gas Demand



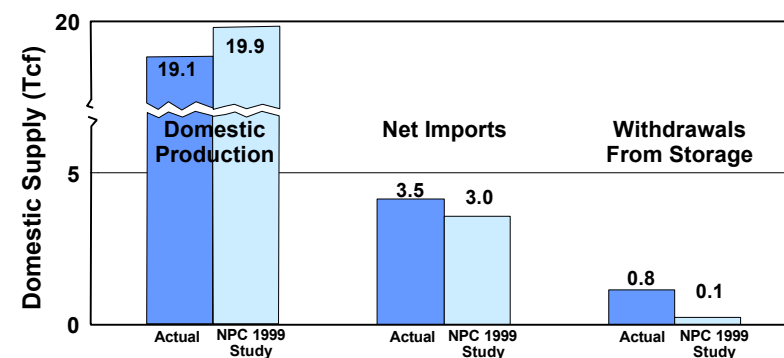
## 3. Domestic Gas Production Has Been Essentially Flat.

U.S. natural gas production has been relatively flat during the past two years, 800 Bcf less than expected in the NPC 1999 Study. Increased imports from Canada and gas storage were used to meet demand.

Adverse market conditions of 1998/99 seriously affected capital investment and well drilling.

- *With increases in drilling activity in 2000, is domestic productive capacity responding?*
- *How much additional Canadian productive capacity will be available in the next five years?*

Figure 2.  
Actual vs. Expected Sources of Natural Gas Supply (2000)



#### 4. Progress in Technology and Access To Resources Remain Major Issues

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##### Technology Progress

Preliminary data for exploration success and rig efficiency show potential declines since the NPC 1999 Study's projected increases.

The NPC Study assumed expected "technological advances based on recent levels of R&D funding and the general effectiveness of those efforts". Actual data shows R&D funding by major energy producers to be declining, potentially impeding technology progress.

- *What will stimulate the industry to invest in new drilling systems?*
- *How might industry and government assure required R&D investments?*

#### 4. Progress in Technology and Access To Resources Remain Major Issues (cont.)

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##### Access

Forest Service Roadless Areas have decreased industry's access to Rocky Mountain resources.

Access to resources in the Eastern Gulf of Mexico and the Alaskan North Slope are topical issues.

- *Can the industry increase supply sufficiently without access to restricted areas?*
- *What technology advances would reduce impact in environmentally sensitive areas?*

#### 5. Natural Gas Prices Have Been Higher Than Anticipated.

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Domestic wellhead prices for natural gas averaged about \$3.70 per Mcf in 2000, with a season spike of nearly \$10 per Mcf in December, 2000 (Henry Hub). The NPC 1999 Study projected increased wellhead prices for 2000 and 2001, though not as high as actual.

- *How significantly will the changes in demand and supply influence future gas price?*
- *What actions might help provide a market-based ceiling on future gas prices?*

#### Summary

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Differences exist between the NPC 1999 Study's anticipated and today's actual conditions in the natural gas industry. *Are these:*

- *Temporary Anomalies (eg. low hydropower)?*
- *Near-Term Constraints (eg. rigs and manpower)?*
- *Longer Term Trends (eg. higher GDP growth; slower technology progress)?*
- *How might the near-term constraints be mitigated?*
- *What are the implications of longer term trends for the natural gas industry?*

DOE Workshop: Surveying the Milestones

## Demand Review

Harry Vidas  
Energy and Environmental Analysis, Inc.

### Outline of Presentation

- Economic Activity
- Oil Prices
- Electricity Sales
- Electricity Generation by Fuel Type
- Generation Balance in 2000
- New Power Plants
- Natural Gas Balance
- Gas Demand by Sector
- Weather Effects
- Observations

## Economic Activity

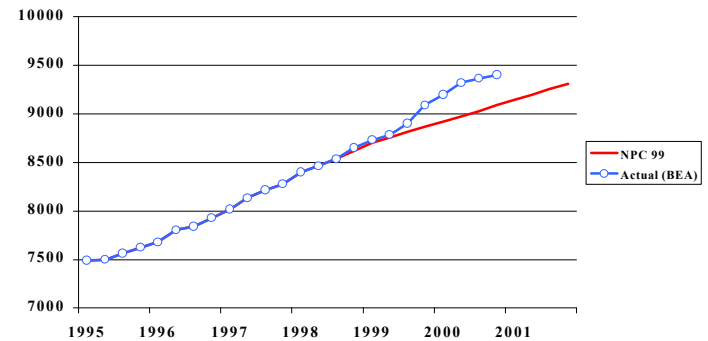
**National Petroleum Council Assumption:** The NPC Reference Case assumed that U.S. Gross Domestic Product (GDP) would grow at 3.3% in 1999 (full year over full year) and an average of 2.5% each year thereafter. Sensitivity cases were run with 3.0% and 2.0% long-run GDP growth.

**Market or Public Policy Change Since 1999 Study:** Actual GDP grew 4.2% in 1999 and 5.0% in 2000. However, the last quarter of 2000 showed growth of only 1.0% on an annual basis.

**Magnitude of Change:** By 2000, actual GDP was 9.402 trillion in 1992 dollars versus an anticipated GDP of 9.087 trillion dollars. This is a difference of 3.5%.

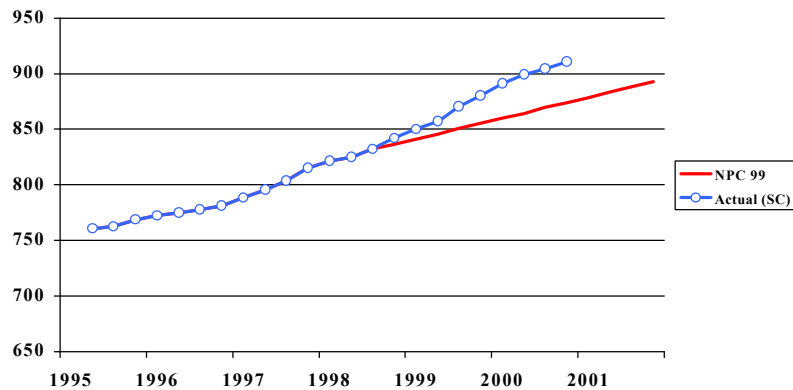
### U.S. Gross Domestic Product

(Billion Chained 1996 Dollars)



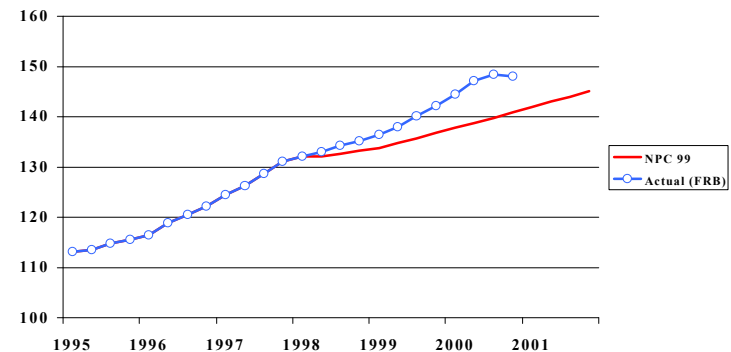
### Canadian GDP

(Billion 1992 Canadian Dollars)



### U.S. Industrial Production Index

(1992 = 100)



## Oil Prices

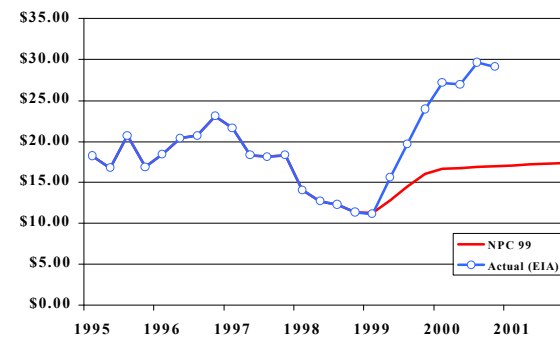
**National Petroleum Council Assumption:** The Reference Case oil price assumption was \$18.50/bbl WTI in real 1999 dollars and \$16.50 for refiners average cost of crude (RACC). These prices were chosen because they are the actual long-run average over several decades. Sensitivity Cases assuming WTI oil prices of plus or minus \$3.50/bbl were also run.

**Market or Public Policy Change Since 1999 Study:** Actual prices were much higher starting in the second half of 1999. Through most of 2000, oil prices were about \$2.00/MMBtu higher than expected.

**Observations:** The high oil prices stimulated upstream activity and led indirectly to higher gas prices through much of 2000 when gas competed with fuel oils at the burner tip.

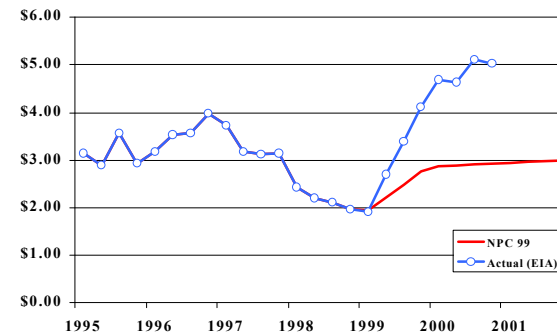
### Oil Price (RACC)

(Nominal U.S. Dollars per Barrel)



### Oil Price (RACC)

(Nominal U.S. Dollars per MMBtu)



## Electricity Consumption

**National Petroleum Council Assumption:** The definition of electricity consumption and sales used in the NPC 1999 study is the equivalent of what EIA calls “sales by utilities” plus “retail wheeling by power marketers.” This total could also be called “sales through the distribution grid.”

Two other categories of electricity consumption tracked by EIA cover on site generation for host use. The first, “nonutility onsite direct use,” covers the traditional generation/cogeneration facilities owned by industrial or large commercial establishments. The second category, “non-utility sales to end users,” is interpreted to be the same thing, except that the generation/cogeneration equipment is owned by a second party and the electricity and thermal energy is sold to the host.

In the NPC projection, all gas use for onsite generation is reported in the appropriate end use sector, mostly industrial or commercial. Only gas used to generate electricity that is sold through the grid is under the “power generation” sector in the NPC tables and figures of results.

Sources: From EIA data in January 2001 *Electric Power Monthly and Monthly Energy Review*. EIA values for 2000 based on applying growth rates of data through October to entire year. Taking into account very cold weather in November/December would yield annual growth in grid sales of about 3.0% instead of 2.65% in 2000.

### EIA Electricity Consumption Estimates (million kWh)

	Annual Growth	
	<u>98 to 99</u>	<u>99 to 00</u>
Sales by Utilities	-012%	#N/A
Retail Wheeling Sales by Power Marketers	212.25%	#N/A
All Sales Through Distribution Grid	1.47%	2.65%
Non-utility Onsite Direct Use	10.10%	#N/A
Non-utility Sales to Endusers	61.71%	#N/A
All Categories	2.26%	#N/A

### EIA Electricity Consumption Estimates (million kWh)

	<u>1998</u>	<u>1999</u>	<u>2000 est.</u>
Sales by Utilities	3,239,818	3,235,899	#N/A
Retail Wheeling Sales by Power Marketers	24,000	76,188	#N/A
All Sales Through Distribution Grid	3,264,218	3,212,087	3,399,947
Non-utility Onsite Direct Use	134,041	147,581	#N/A
Non-utility Sales to Endusers	25,777	41,683	#N/A
All Categories	3,424,036	3,501,351	#N/A

## Electricity Sales

**National Petroleum Council Assumption:** Projected electricity sales through the grid grew 2.4% in 1999 and 2.3% in 2000 in the NPC Reference Case.

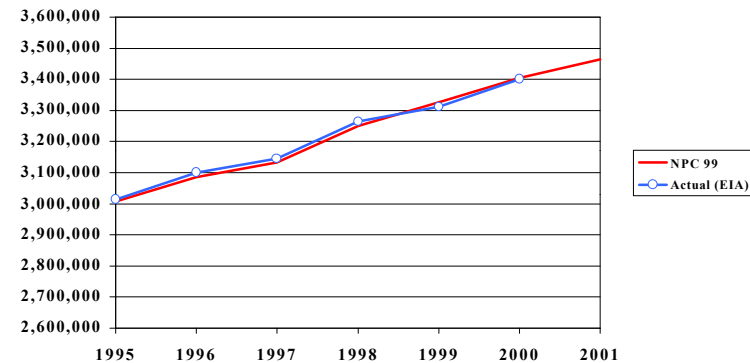
**Market or Public Policy Change Since 1999 Study:** Actual growth was lower in 1999 (1.5%), but higher in 2000 (2.7%).

**Magnitude of Change:** The average growth over the two years for the NPC projection and estimated actuals are nearly the same.

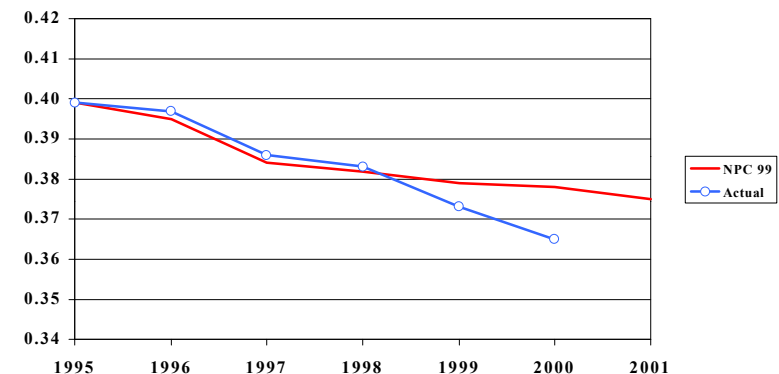
**Observations:** Despite the fact that the NPC Reference Case underestimated economic growth in the last two years, electricity sales were close to actuals. This means that the economy's need for electricity per unit of GDP (electricity intensity) was lower than anticipated. By 2000, the U.S. economy was using 3.4% less electricity per unit of output than expected in the NPC Reference Case.

The long-run income elasticity for electricity grid sales assumed by the NPC averaged 0.80 across all regions of the U.S. That is, if the economy grew 2.5% per year, then electricity sales would grow 2.0%. If future growth in the economy continues to be concentrated in low energy-intensive services and high-tech industrial sectors, the overall income elasticity used by NPC may prove to be too high.

### U.S. Electricity Sales (Million kWh)



### U.S. Electricity Intensity (kWh Sales/Dollar of GDP)



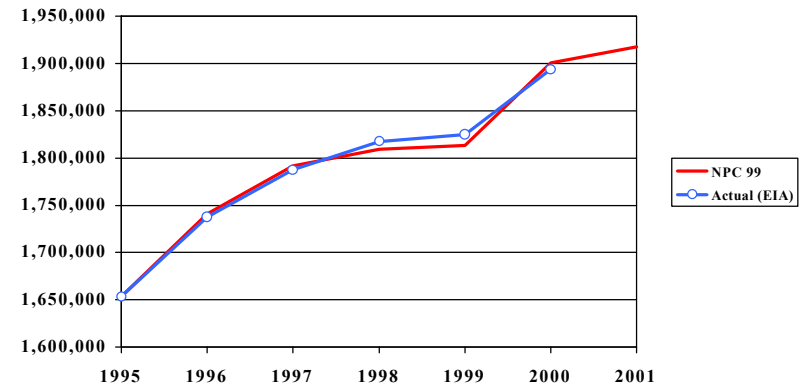
## Coal Generation

**National Petroleum Council Assumption:** The Reference Case results were 1,901 billion kWh of coal generation in 2000.

**Market or Public Policy Change Since 1999 Study:** Actual generation was slightly below this at an estimated 1,894 billion kWh in 2000. (Data for coal and other fuels through October 2000 are from EIA Electric Power Monthly with last two months of 2000 estimated by EEA.)

**Observations:** The actual capacity utilization rate for the coal units achieved in 2000 was approximately 67% on average. The expectation in the NPC Reference Case was for the average utilization to reach 75%, which would mean generation of about 2,100 billion kWh by 2010 (assuming 320 GW of coal capacity). EPRI reports that coal units have a weighted average Equivalent Availability Factor of 83%. (Generating Unit Statistical Brochure, August 1999) This means that the NPC long-run utilization target is only about 90% of what is hypothetically achievable based on actual unit availabilities. Still, this assumption was seen by many participants as very ambitious, so a sensitivity case of the power sector model was run at lower maximum coal capacity utilization rates. Since maximum coal plant use is now limited by off-peak electricity demand, we won't know what the coal plants can do until the electricity demand grows to the point where the coal plants will be called on to generate at full load for more hours each day.

### U.S. Coal Generation (Million kWh)





## Nuclear Generation

**National Petroleum Council Assumption:** The NPC Reference Case assumed that nuclear plants would generate 673 billion kWh in 1999 and 658 billion kWh in 2000.

**Market or Public Policy Change Since 1999 Study:** Actual generation was much higher: 728 billion kWh in 1999 and 738 billion kWh in 2000.

**Magnitude of Change:** The difference between projected and actual nuclear generation in 2000 is 80 billion kWh. At an average heat rate of 10,300 Btu/kWh, this represents the backing out of about 824 trillion Btus of fossil energy use (an equivalent of 800 bcf of natural gas).

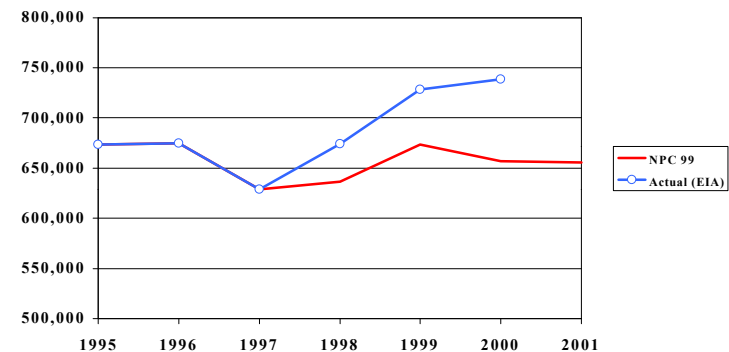
**Observations:** If the high capacity utilization rates recently achieved by nuclear plants can be sustained, the need for fossil fuels to generate electricity for grid sales (all other things being equal) would be lower in the long run than anticipated in the NPC Reference Case.

The recently experienced high gas and electricity prices make nuclear plants more economic to operate. This has led to high sales prices for nuclear plants and a large number of filed and anticipated requests for license renewals. The pattern for re-licensing, so far, is about as anticipated in the NPC study.

## Nuclear Re-licensing

- NPC Reference Case assumed that about 15,000 MW of nuclear capacity retiring before 2015 would be re-licensed, leaving 80,400 MW operating in 2015.
- Since report:
  - 4,200 MW of capacity has been granted 20-year extension
  - 3,800 MW additional has applied for extension
  - 24,000 MW has announced intent to apply for extensions
- If all these apply and are approved, 79,200 MW will be operable in 2015. (Many of the extensions are for the newest units with retirement dates after 2015).

## U.S. Nuclear Generation (Million kWh)



## Hydro and “Other” Generation

**National Petroleum Council Assumption:** Anticipated hydro generation was 308 billion kWh in 1999 and 2000. This was based on a multi-year average of precipitation patterns that discounted the unusually wet years of 1997 and 1998.

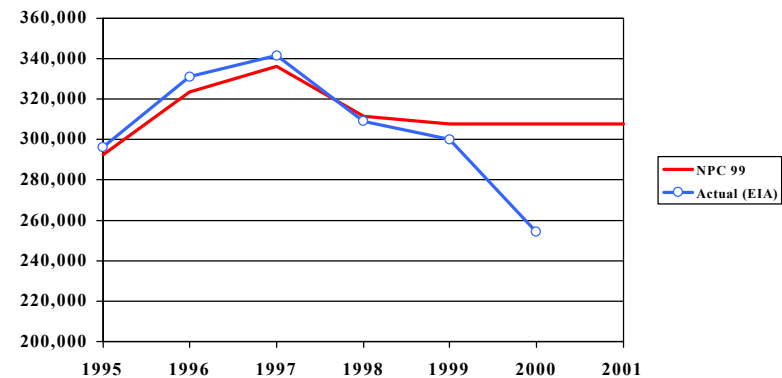
The category “other” includes geothermal, solar and wind generation. These categories were expected to contribute about 10 billion kWh in 2000.

**Market or Public Policy Change Since 1999 Study:** Actual hydro generation was 300 billion kWh in 1999 and fell significantly to 254 billion kWh due to dry weather in 2000.

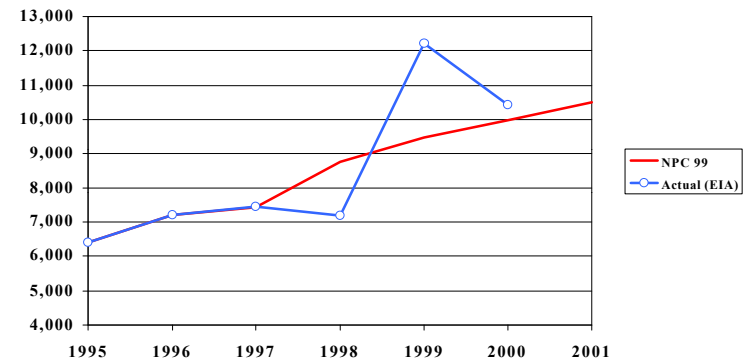
**Magnitude of Change:** The shortfall in hydro occurred throughout the country, but was most significant in the west. The difference of 54 billion kWh between the NPC projection and estimated actuals for 2000, is equivalent to about 556 trillion Btus of energy inputs in fossil power plants (540 Bcf of gas).

**Observations:** Although the year 2001 is looking to be another dry one, the long-run average hydro expectations in the NPC Reference Case may still be valid, unless environmental concerns limit the use of existing hydro facilities.

### U.S. Hydro Generation (Million kWh)



### U.S. “Other” Generation (Million kWh)



## Oil and Gas Generation

### National Petroleum Council

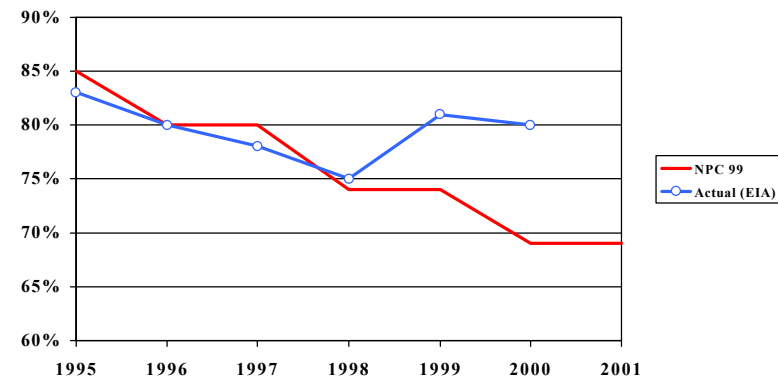
**Assumption:** Generation from oil and gas in the NPC 1999 study was expected to be 482 billion kWh in 1999 and 516 billion kWh in 2000.

**Market or Public Policy Change Since 1999 Study:** The actual generation was close to projections: 474 billion kWh in 1999 and 515 billion kWh in 2000.

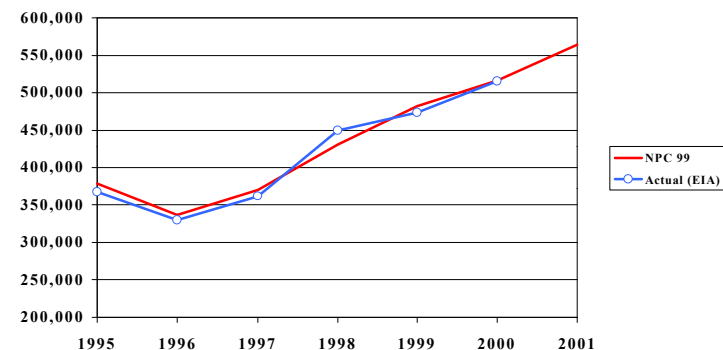
**Magnitude of Change:** Total generation from oil and gas units was very close to NPC Reference Case projections, but the market share for gas was understated in 1999 and even more in 2000. The understatement of gas market share in 2000 was due in large degree to the fact that oil prices turned out to be much higher than expected. Also, although the total oil/gas generation was on target, the actual regional mix saw much more generation in the West, where the existing steam units in California were operated at very high utilization rates in 2000. These units are generally not switchable to oil due to environmental regulations.

**Observations:** The long-run expectation in the NPC case was that 75% of new gas-fired plants would be switchable to distillate fuel oil. This meant that a substantial portion of their energy use was met with oil. If doesn't happen - either because oil prices are higher than were expected in the NPC study or because oil burning equipment is not installed - gas use in the new units would be higher. However, because of the resulting higher operating costs for the new gas units, coal would become more economic and fewer gas units might be built.

## Gas Market Share of O/G Generation (Percent)



## U.S. Oil & Gas Generation (Million kWh)



## Total Generation

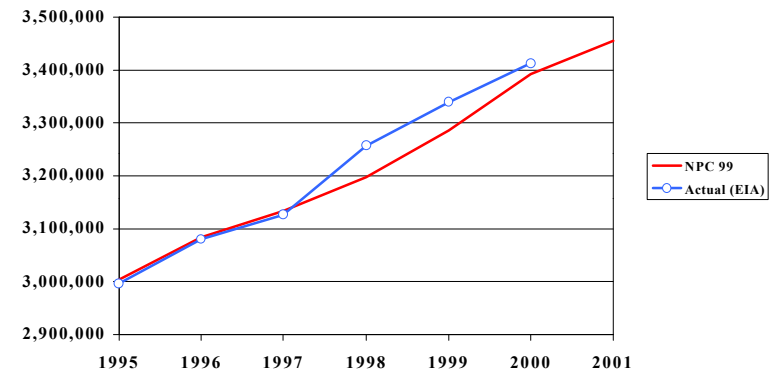
**Magnitude of Change:** The differences between the 2000 NPC projection and actuals are:

- Coal too high by 7 billion
- Nuclear too low by 81 billion kWh
- Hydro too high by 53 billion kWh
- Oil too high by 56 billion kWh
- Gas too low by 55 billion kWh
- Total too low by 20 billion kWh

**Observations:** The understatement of gas use for power generation in 2000 by 55 billion kWh represents approximately 540 Bcf of gas.

## U.S. Total Generation for Grid

(Million kWh)



## U.S. Electricity Generation: 2000

	NPC Reference Case	Actual (est. from EIA)	Percent Difference
Coal	1,901,324	1,893,820	-0.4%
Nuclear	657,572	738,436	11.0%
Hydro	307,724	254,224	-21.0%
Oil & Gas	516,130	515,373	-0.1%
<i>Oil</i>	158,002	102,083	-54.8%
<i>Gas</i>	358,128	413,290	13.3%
"Other"	9,975	10,431	4.4%
<b>Total</b>	<b>3,392,725</b>	<b>3,412,284</b>	<b>0.6%</b>

## Recent New Power Plant Construction

National Petroleum Council Assumption: The NPC study assumed that about 30 GW of new gas and oil power plants would be added by 2000. About 9 GW was expected to be combined cycle and the remainder of 22 GW a combination of steam plants (ST), combustion turbines (CT) and internal combustion engines (IC).

**Market or Public Policy Change Since 1999 Study:** The estimated actual plants totaled about 38 GW. (Data are from EIA's power plant data base and Electric Power Monthly for 1999 and 2000. Values for 2001 are EEA estimate based on many sources.)

**Magnitude of Change:** The installed capacity of oil and gas power plants for grid sales was approximately 255 GW at the end of 2000. Plants added since 1998 represent about 15% of that total.

**Observations:** An additional 47 GW of oil and gas power plants are expected to be installed in 2001. This would be an addition of 6.3% to the total installed base for grid sales of 750 GW (all fuel types) at the end of 2000.

The dispatch of these new plants will depend on many factors including total electricity sales, load shape, fuel prices and the availability of hydro and nuclear units.

### New Oil and Gas Powerplants

(cumulative MW added since 1/1/98)

	<u>NPC Reference Case</u>			<u>Estimated Actual</u>		
	Combined Cycle	ST/CT/ IC	All Oil & Gas	Combined Cycle	ST/CT /IC	All Oil & Gas
1999	4,385	12,448	16,833	4,369	9,827	14,196
2000	8,130	21,785	29,915	9,206	29,032	38,238
2001	11,020	29,406	40,426	13,706	71,332	85,038
2005	23,028	58,959	81,987			
2010	37,744	88,436	126,180			

## Planned Coal and Other Power Plants

**National Petroleum Council Assumption:** Only the small number of new coal plants that were planned at the time of the study were assumed to be built before 2010. There were no “unannounced” coal plants in the NPC projection before 2010.

**Change Since 1999 Study:** Several additional coal plants have actually been announced. If they are all built, the inventory of coal plants will be about 12 GW greater by 2005 than assumed by the NPC (about 332 GW versus 320).

**Magnitude of Change:** If the 12 GW were operated at 75% capacity utilization and displaced only gas generation, the loss to the gas market would be 550 bcf or more per year.

**Observations:** If gas price stay high, even more new coal plants likely will be built. The limits to new coal plants are economic and environmental. “Multi-pollutant” power plant limits now being discussed in Washington would create limits on carbon dioxide and other emissions and might reduce the attractiveness of coal.

## New Coal Power Plants

- NPC Reference Case:
  - 4,600 MW of new coal plants would be built in the period of 1998 to 2010.
  - Another 15,400 were assumed between 2010 and 2015.
- Through end of 2001, 2,400 MW actually will have been added.
- Due to high gas and electricity prices, several new coal plants have been announced in the last few months.
- Planned coal units after 2001 now total about 12,000 MW

## Planned Power Plants

(2002 and later, in MWs)

Comb. Cycle O&G	30,000
CT/ST/IC O&G	170,000
Coal	12,000
“Other”	12,000
Total	224,000

## Gas Balances

**Observations:** The only comprehensive statistics on U.S. natural gas demand are collected and published by the U.S. Energy Information Administration. Since 1999, the so called “balancing item,” which is the difference between estimated demand and supply, has grown significantly.

Comparison of U.S. Gas Balances								
	<u>NPC Gas Balance</u>				<u>EIA Gas Balance</u>			
	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>
Dry Production (1)	18.90	19.29	19.59	19.89	18.90	18.71	18.62	19.14
Supplementals	0.12	0.12	0.12	0.12	0.10	0.10	0.10	0.10
Net Imports	2.60	2.62	29.93	2.99	2.84	2.99	3.42	3.50
Net Storage	0.03	(0.52)	0.19	0.08	0.02	(0.53)	0.17	0.91
<b>Balancing Item</b>	<b>0.25</b>	<b>(0.17)</b>	<b>(0.18)</b>	<b>(0.19)</b>	<b>0.09</b>	<b>(0.01)</b>	<b>(0.61)</b>	<b>(0.97)</b>
All Supply	21.90	21.34	22.65	22.89	21.96	21.26	21.70	22.68
Lease & Plant	1.23	1.24	1.25	1.26	1.20	1.16	1.08	1.25
Pipeline	0.73	0.71	0.75	0.77	0.75	0.64	0.74	0.74
Residential	4.97	4.55	5.01	5.32	4.98	4.52	4.73	5.00
Commercial	3.22	2.96	3.22	3.41	3.22	3.06	3.05	3.38
Industrial	8.84	8.66	8.82	8.61	8.83	8.69	9.00	9.33
Electric Utility (2)	2.93	3.22	3.59	3.51	2.97	3.26	3.11	2.97
Total Consumption	21.92	21.34	22.64	22.88	21.96	21.31	21.70	22.68
<i>Industrial &amp; Utility</i>	<i>11.77</i>	<i>11.88</i>	<i>12.41</i>	<i>12.12</i>	<i>11.80</i>	<i>11.94</i>	<i>12.11</i>	<i>12.31</i>

## An Alternative Balance

**Issue:** The large balancing items in the EIA consumption suggests that production or imports may be overstated or consumption is understated in 1999 and 2000.

**Observations:** The balance that EEA is presenting assumes that U.S. production went up only about 200 bcf per year between 1999 and 2000. This is consistent with our review of available production data and our interpretation of announced production by 60 larger U.S. gas producers. EEA's U.S. gas production estimates are higher than EIA values for all years due to methodological differences chiefly related to non-hydrocarbon gas adjustments in the Rockies.

EEA consumption estimates for residential and commercial sectors are nearly identical to EIA: minor differences related to EEA's use of "real time consumption" estimates versus EIA's "as billed" concept.

Biggest differences are in industrial/power generation sectors where EEA shows 300 bcf more consumption in 1999 and 700 bcf more in 2000.

### U.S. Gas Production from EEA60 (Bcfd)

	4th Qtr 2000	4th Qtr 1999	Change	Percent Change	Percent of Production
<b>Top 10 Producers</b>	18.5	19.1	-0.6	-3.1	34.5
<b>Next 50 Producers</b>	14.3	13.7	0.7	4.8	26.7
<b>Unsampled U.S. Producers</b>	20.8	19.8	1.0	4.8	38.8
<b>Total U.S. Gas Production</b>	53.6	52.6	1.0	2.0	100.0

Notes:

1. EEA60 is a sample consisting of the top 60 U.S. producers.
2. All gas production includes royalty gas.
3. Production change for unsampled producers has been derived by assuming the same percent change as for the Next 50 Producers in EEA60.

### Alternative Gas Balance

	1997	1998	1999	2000
U.S. Production	19,339	19,181	18,998	19,220
Net Canada/LNG/Mexico Imports	2,849	3,011	3,332	3,432
Supplemental Gas	103	102	98	101
<b>Total Supply</b>	22,291	22,294	22,428	22,753
Residential	4,983	4,499	4,768	5,093
Commercial	3,229	2,957	3,116	3,307
Industrial	8,846	8,741	8,827	8,724
Power Generation	2,966	3,385	3,589	4,240
Lease and Plant	1,239	1,238	1,248	1,262
Pipeline Fuel	767	741	781	775
<b>Total Gas Consumption</b>	22,030	21,561	22,329	23,401
<b>Net withdrawals/(Injections)</b>	31	-520	138	925
<b>Balancing Item (D-NW-S)</b>	-292	-213	-237	-277



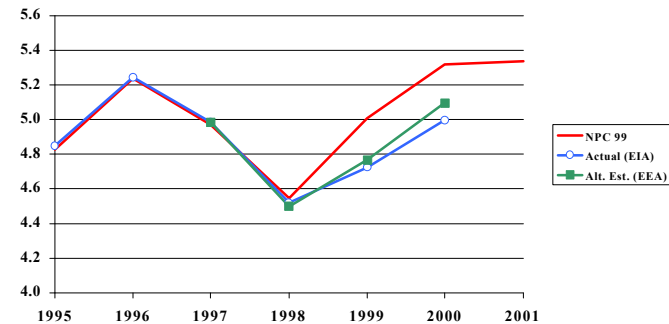
## Residential and Commercial Gas Consumption

**National Petroleum Council Assumption:** Residential gas use was expected to be about 5.0 Tcf in 1999 and 5.3 Tcf in 2000. Commercial use was expected to be about 3.2 and 3.4 Tcf in those two years.

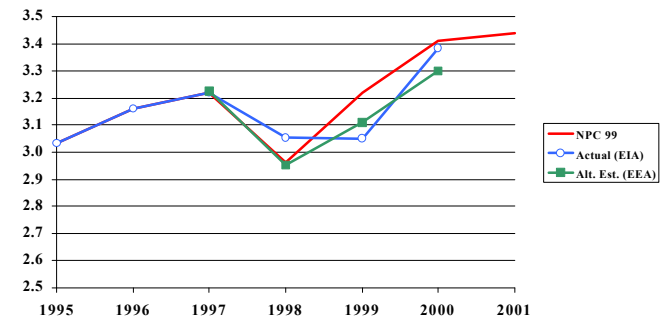
**Market or Public Policy Change Since 1999 Study:** Actual gas in residential sector was a little over 0.2 Tcf lower in each year. Commercial use was about 0.1 Tcf lower. In both instances, warmer than expected weather is the main cause.

**Observations:** The EIA estimate of commercial gas use in 2000 is unexpectedly large given weather patterns. The EEA estimate is smaller and looks more like the residential year-to-year changes. If it turns out that the EIA data for 2000 are correct, it would be worthwhile figuring out what's causing this increase in commercial gas use.

U.S. Residential Gas Demand  
(Tcf per Year)



U.S. Commercial Gas Demand  
(Tcf per Year)



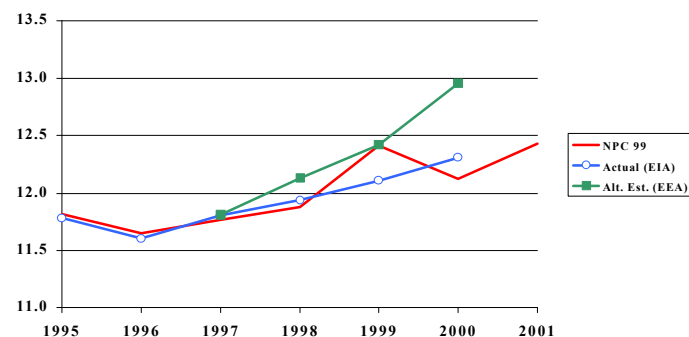
## Industrial & Powerplant, Total Demand

**National Petroleum Council Assumption:** The gas use in industrial and power plant sectors was expected to be 12.4 Tcf in 1999. With the anticipated increase in gas prices (in an environment of low oil prices) in 2000, consumption was expected to fall to 12.1 Tcf.

**Market or Public Policy Change Since 1999 Study:** Actual demand (per EEA) in 1999 was very close to the NPC projection. Because of the higher than expected oil prices in 2000 and the fact that much of the increased energy demand for power generation was in relatively unswitchable California plants, the expected switching to fuel oil did not take place and demand was 0.9 Tcf higher than the NPC projection.

Total projected NPC demand for all end use sectors plus lease & plant use and pipeline use was about 0.3 Tcf too high in 1999 (primarily due to warm weather impacts in the residential and commercial sector) in the NPC projection. In contrast, total demand was about 0.5 Tcf too low in 2000. Roughly speaking, this difference in 2000 is made up of an underestimation of 0.9 Tcf in the industrial and power plant sectors and an overestimation of 0.3 in the residential and commercial sectors.

U.S. Industrial and Power  
Plant Gas Demand  
(Tcf per Year)



## Weather

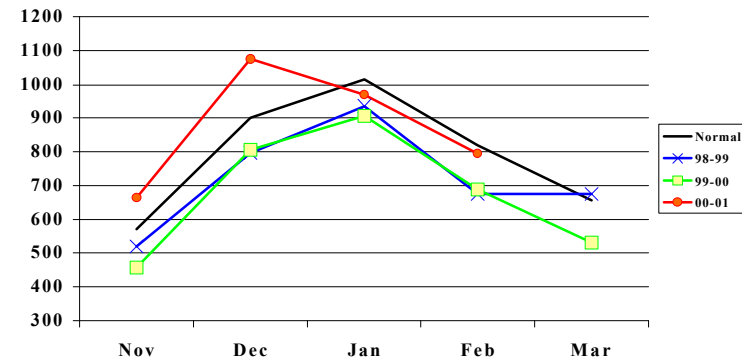
**National Petroleum Council Assumption:** For all forecast months, the NPC assumed the NOAA official “normal” weather, that is, the population weighted average for each region over the years 1960 to 1990.

**Market or Public Policy Change Since 1999 Study:** The winters of 98/99 and 99/00 were both substantially warmer than normal. The winter of 00/01 started out much colder than normal.

**Magnitude of Change:** These differences in HDDs subtract about 200 bcf off of residential and 100 bcf off of commercial demand in calendar year 1999. This was essentially all of the difference between the NPC projection and “actuals” for the two sectors.

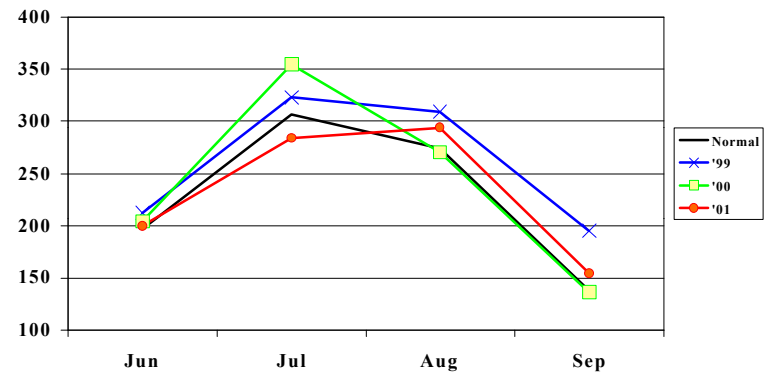
### Heating Months

U.S. Average HDDs



### Cooling Months

U.S. Average CDDs



## December 2000

**National Petroleum Council Assumption:** Due to time and budget limitations, the NPC study did not conduct weather scenarios to look at impacts of weather on electricity and gas demand or changes to hydro power.

**Observations:** Based on the average temperatures in the three years 1997 to 1999, a demand level of about 80 Bcfd would have been expected for December 2000. The unusually dry weather reduced hydro generation and added about 1 Bcfd to gas demand. The unusually cold weather added another 15 Bcfd, bringing total potential demand to about 96 Bcfd.

Even with large storage withdrawals, gas supplies only totaled 90 Bcfd from all sources, including extra ethane and propane left in plant residue gas. Extremely high prices were needed to shed 6 Bcfd of load from power plant and industrial sectors so as to bring total consumption in line with available supply.

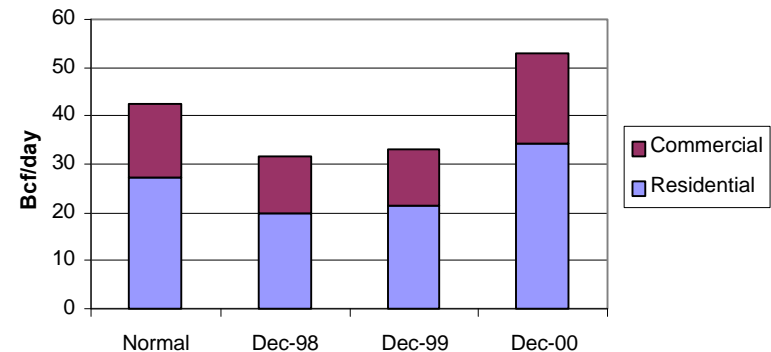
### December 2000 “The Perfect Storm”

- Gulf Coast gas prices rose to more than \$8.00 per MMBtu
  - almost four times higher than the previous year
- Southern California prices averaged more than \$25 per MMBtu
- Average New York prices approached \$13 per MMBtu

## December 2000; “The Perfect Storm”

- Following a cold November, December was over 20% colder than normal.
- Going into December, gas prices were already above oil product prices.
  - Supply/demand balance was tight even as end-users that could switch to oil easily had already done so.
- To bring the market into balance, prices had to rise to levels that cause less price sensitive customers to reduce gas consumption.
  - Ammonia and methanol plants shut down.
  - Industrial production slowed at least in part because of high production costs.

**US Residential and Commercial Sector  
Gas Consumption (Bcf/day)**



## December 2000 (continued)

### Observations

#### Observations on Demand Milestones

- Oil Prices
- Economic Activity vs. Energy Use
- New Power Plant Capacity
- Fuel Switchability in O/G Power Plants
- Resurgence of Coal in Power Generation
- Sustainability of Nuclear's High Utilization Rates
- Weather Effects
- Quality of Gas Consumption Data

#### U.S. Gas Balance (Bcfd)

	4th Qtr 2000	4th Qtr 1999	Change	Percent Change
<b>Total Gas Supply</b>	<b>72.3</b>	<b>65.8</b>	<b>6.5</b>	<b>9.9</b>
U.S. Dry Gas Production	53.5	52.6	0.9	1.7
Net Imports	9.7	8.6	1.1	12.8
Net Storage Withdrawals	8.7	4.3	4.4	102.3
Supplemental Gas	0.3	0.3	0.0	0.0
Ethane Rejection <sup>1</sup>	0.1	0.0	0.1	NA
<b>Total Gas Demand</b>	<b>72.2</b>	<b>65.2</b>	<b>7.0</b>	<b>10.7</b>
Residential Sector	21.2	16.3	4.9	29.8
Commercial Sector	12.6	10.2	2.4	23.6
Industrial Sector	23.4	24.8	-1.4	-5.8
Power Generation	9.2	8.1	1.1	13.6
Lease and Plant Gas	3.5	3.5	0.0	1.2
Pipeline Fuel	2.2	2.2	0.0	0.7
<b>Imbalance (S-D)</b>	<b>0.1</b>	<b>0.6</b>	<b>-0.5</b>	<b>-78.7</b>

<sup>1</sup> Volume of ethane and propane retained in gas. Normally, these hydrocarbons are removed from the gas stream, but some ethane and propane are not removed when natural as prices increased to over \$7/MMBtu during December 2000.

#### Electricity Use by Office and Network Equipment

- U.S. electricity sales grew 2.3 % per year between 1996 and 1999, on tract for 2.7% growth between 1999 and 2000 (*Electric Power Monthly, January 2000*)
- Office and network equipment electricity use estimated at 74 billion kWh in 1999 (*June 2000 LBL study*)
- Annual Energy Outlook 2001 projections, 1999-2020
  - Residential and Commercial PC-related electricity use: 4.3% average annual growth (additional 70 billion kWh/year to 2020)
  - Other commercial office equipment electricity use: 4.1 % annual growth (additional 116 kWh by 2000)

DOE Workshop: Surveying the Milestones

## Supply Review

Vello Kuuskraa and Jeffrey Eppink  
Advanced Resources International, Inc.

### Outline of Presentation

- Natural Gas Resource Base
- Domestic Gas Production
- Gas Imports and Exports
- Technology Progress
- Access to Resources
- Financial Requirements
- References

## Natural Gas Resource Base

**National Petroleum Council Assumption:** 1,466 Tcf Total Remaining Resources in Lower-48; 313 in Alaska and 667 in Canada based on assessments developed by the Supply Task Group of the NPC. Alaskan resources were not independently evaluated in the 1999 NPC 1999 Study, but USGS estimates were used.

**Market or Public Policy Change Since 1999 Study:** The MMS and USGS continue to update previous assessments. MMS' 2000 assessment<sup>1</sup> of Gulf of Mexico resources has nearly tripled in size relative to its previous 1995 assessment<sup>2</sup>. No other significant changes have occurred to date.

The USGS is currently performing assessments of technically recoverable oil and gas resources in selected basins (Uinta-Piceance, Appalachian, San Juan, Permian, San Joaquin, Alaska and Gulf Coast)<sup>3</sup>. These assessments are scheduled to be completed during the current FY through FY 2004 and are generally expected to increase the resource base.

**Magnitude of Change:** Sensitivity analyses from the NPC 1999 Study indicate Larger and Smaller Resource Bases (+/- 250 Tcf nominally) had the greatest impact on gas production and wellhead price of any of ten sensitivity cases evaluated. For example, in the Larger Resource Base sensitivity, Lower-48 gas production in 2010 is 1.8 Tcf higher than the reference case and Henry Hub natural gas prices (1998\$) are \$0.96 per MMBtu lower in 2010.

### Context/Observations:

- Experience shows that estimates of the size of the undiscovered resource base increase with successive assessments, a phenomenon that occurs at national and regional (Slide S1) as well as play levels. The Council's 1999 Study identified increases in undiscovered resources (30% and 28% in reserves growth and new fields, respectively) 1992 compared to 1999. Lower-48 Remaining Resources of 1,466 Tcf in the NPC 1999 Study represent a 13.2% (171 Tcf) increase from the 1,295 Tcf of the 1992 Study.

### Natural Gas Resource Base Has Increased Over Time

• <b>NPC: US and Canadian Resources*</b> (Lower-48, Alaska, and Canada)	<b>2,215 Tcf ('92)</b>	<b>vs.</b>	<b>2,446 Tcf ('99)</b>
• <b>Gulf of Mexico Deepwater*</b>			
– <b>MMS</b>	<b>61Tcf ('95)</b>	<b>vs.</b>	<b>171 Tcf ('00)</b>
– <b>NPC**</b>	<b>57 Tcf ('92)</b>	<b>vs.</b>	<b>139 Tcf ('99)</b>

\*Remaining technically recoverable resources as of the date of the assessments.

\*\*New fields estimates.

### Slide S1

- As more is learned about domestic gas resources — deep gas in on-shore formations, basin center and other unconventional gas in the Rockies, the size and productivity of deepwater fields in the Gulf of Mexico, and how already discovered fields can be more intensely developed — the Nation will gain confidence that sufficient natural gas resources will exist well into this century. The critical issue is converting these resources, found in increasingly complex and challenging settings, into reserves and readily available productive capacity.

## Domestic Gas Production

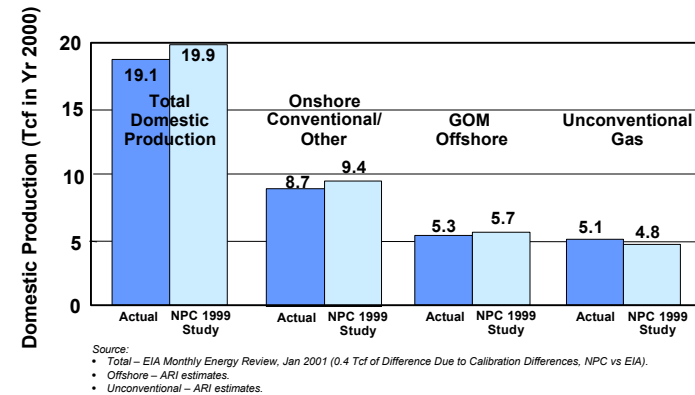
**National Petroleum Council Assumption:** Production in the year 2000 in the NPC Reference Case is 19.9 Tcf (Slide S2). Market or Public Policy Change Since 1999 Study: With increasing commodity prices, industry activity has rebounded from the 1998/99 slump, resulting in increased drilling operations.

**Magnitude of Change:** Onshore conventional production and GOM are less than the NPC Reference Case; in contrast, unconventional production is greater than the NPC Reference Case by 6% (Slide S2). For unconventional gas, tight gas production shows an increase of 6% over the NPC Reference Case, while CBM production is a robust 18% greater than the NPC Reference Case (Slide S3). In the GOM, shallow water production is in decline (7% less than the NPC Reference Case), while deepwater production is on track (Slide S4). Although industry activity has increased (drilling is ahead of the NPC Reference Case by about 10%, Slide S5), production for the year 2000 lags the NPC Reference Case by about 4%.

### Context/Observations:

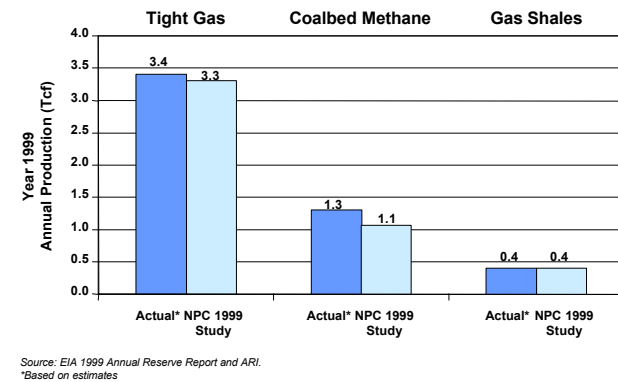
- U.S. drilling activity has clearly increased in the past year (Slide S6). The reasons for the production response lag are unclear, but could represent transitory time lag, a mix of drilling (infill, step-outs versus exploration wells) or, of more consequence, a poorer quality remaining undiscovered resource base than anticipated, especially for areas such as the shallow GOM.
- A poorer quality resource base could be manifested by accelerated depletion. A recent study by DOE<sup>4</sup> on this topic concluded that accelerated depletion can lead to lower production and higher prices as, over time, adding reserves becomes increasingly difficult. The study further indicates that a combination of faster development of technology and increased access to unconventional gas resources in the Rocky Mountains could be expected to ameliorate the effects of accelerated depletion.

### Domestic Gas Production for 2000 is Below Expectations, Except Unconventional Gas



Slide S2

### Unconventional Natural Gas Production Has Developed More Rapidly Than Expected



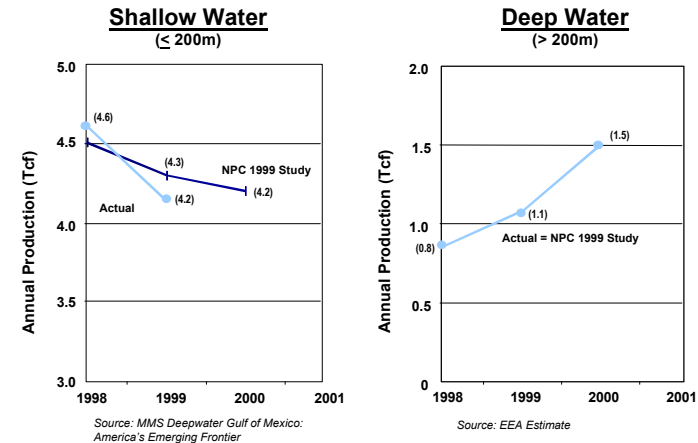
Slide S3



## Domestic Gas Production (continued)

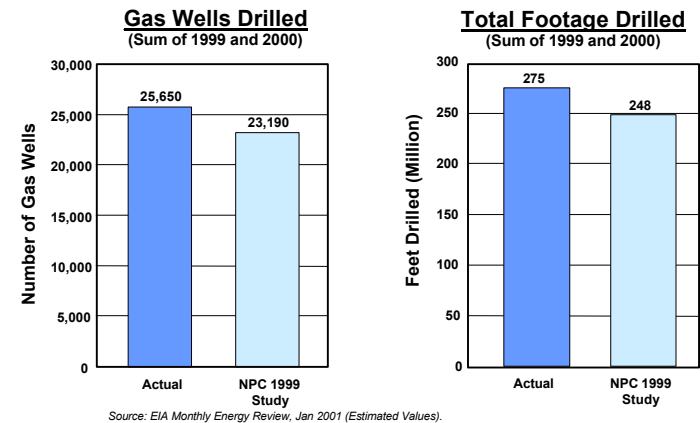
- Is the domestic rig fleet reaching capacity (onshore and offshore, Slide S7) and, if so, will the industry make the necessary investments in new drilling systems? The NPC Reference Case shows that the number of oil and gas wells drilled annually will double to an estimated 48,000 by 2015. Discovered resources from areas that are not currently part of the supply chain could come onstream in the medium term from such areas as the North Slope Alaska and the MacKenzie Delta (35<sup>5</sup> and 9<sup>6</sup> Tcf, respectively).
- The NPC 1999 study notes that impending shortages of qualified personnel are expected to hinder the ability of the producing sector to find and develop required gas supplies and shows a decline of about 50% in U.S. employees in oil and gas extraction activities 1996 to 1996. According to a recent O&G Journal article<sup>7</sup>, a survey of companies indicated that 70% expressed concern over a lack of equipment to carry out their drilling programs and, a substantial majority was concerned about the availability of qualified personnel.

### Natural Gas Production from the Gulf of Mexico Shallow Water in Decline; Deep Water on Track



Slide S4

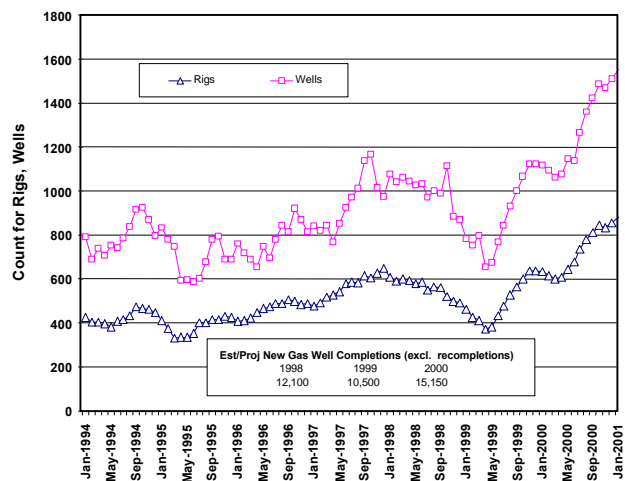
### Actual Gas Wells and Total Feet Drilled in 1999 & 2000 Have Exceeded the NPC Reference Case



Slide S5

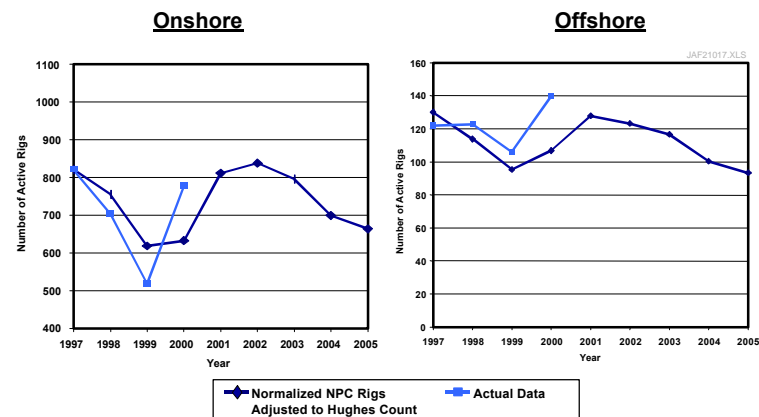
# Domestic Gas Production (continued)

## U.S. Gas Drilling Activity Levels



Slide S6

## Domestic Onshore and Offshore Rig Fleet



Slide S7

## Gas Imports and Exports

**National Petroleum Council Assumption:** U.S. natural gas imports from Canada in the NPC Reference Case are 3 Tcf in year 2000 (Slide S8). Exports to Mexico were assumed to be 47 Bcf in 2000. Net LNG import were assumed to be about 50 Bcf in 2000.

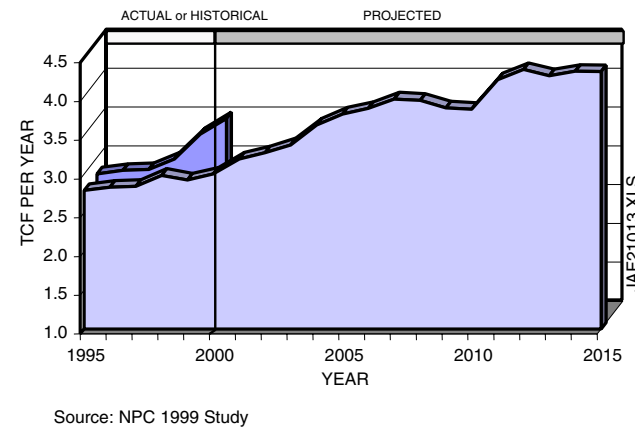
**Market or Public Policy Change Since 1999 Study:** The Alliance pipeline became operational December 2000, increasing Canada's future export capacity by 1.3 Bcf/day<sup>8</sup>. With increased gas prices and more competitive LNG costs, LNG facilities in Boston Harbor MA, Lake Charles, LA, Cove Point, MD, and Elba Island, GA, are being expanded or recommissioned. These modest expansions could total 4.5 Bcf/d send-out capacity<sup>9</sup>. Prospects for increased natural gas development in Mexico (30 Tcf reserves)<sup>10</sup> may be improving considering discussions between presidents Bush and Fox. The tariff on Mexican imports of U.S. natural gas was eliminated in mid-1999<sup>11</sup>, which could act to encourage continued and growing volumes of imports in the future.

**Magnitude of Change:** Actual imports from Canada in 2000 were 3.5 Tcf, 17% greater than the NPC Reference Case. In 1999, U.S. imports of LNG nearly doubled from the previous year to 163 Bcf from 85 Bcf. Mexico is currently a small net importer of U.S. natural gas (~50 Bcf/yr)<sup>12</sup>.

### Context/Observations:

- The performance of the natural gas industry in Canada will have a significant impact on U.S. supply. The Western Canadian Sedimentary Basin (WCSB) dominates the natural gas supply for Canada. Light oil production is declining in the WCSB while heavy oil production is ramping up; this situation will affect Canadian gas supply as associated gas production declines and gas usage by the heavy oil industry increases. Increasing amounts of gas are being supplied to the U.S. from the Scotia Shelf developments, where export is expected to increase to 1 Bcf/d to New England by 2010. Capital require-

Canada Has Stepped Up to the Plate  
U.S. Gas Imports from Canada, Actual vs. Projected



### Slide S8

ments, access, deeper wells and pipeline gathering/processing will continue to affect the ability of Canadian producers to meet export demand.

- Pemex plans to increase Mexican-U.S. border infrastructure and capacity, and to focus more on natural gas exploration activities. A consortium of Semptra, PG&E, and Mexico's Proxima Gas plans to build a 400 Mcf/d pipeline by 2003 connecting the U.S. and Mexican natural gas grids<sup>13</sup>. El Paso NG has proposed installation of an LNG terminal in Baja Mexico to service the California market. Located in northeastern Mexico, the Burgos Basin, is expected to contain massive volumes of largely non-associated, recoverable natural gas resources.
- The U.S. currently exports small amounts of LNG to Asia (~65 Bcf/yr)<sup>14</sup>.

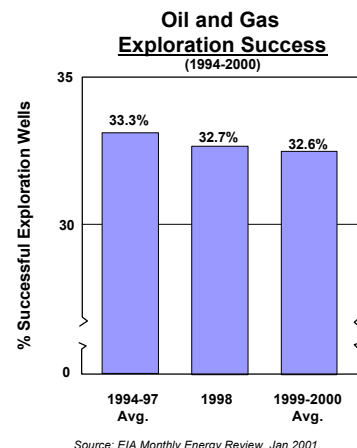
# Technology Progress

**National Petroleum Council Assumption:** Fundamental technology progress can be attributed to changes in exploration success rates and drilling efficiency (footage drilled per rig per year). Exploration success rates were assumed to improve at an annual rate of 1.5% annually (Slide S9). Drilling efficiency was assumed to improve 1.25% annually for onshore and shallow GOM and 1.5% for deepwater GOM (Slide S10).

**Market or Public Policy Change Since 1999 Study:** Rates of R&D funding appear to be declining, lead by major producers, whose funding declined by more than 50% in the 1990s (Slide S11). GRI/GTI has ceased to be a major source of R&D<sup>15</sup> (Slide S12). DOE natural gas R&D funding has been increasing modestly over the past three years (from \$25 to \$33 million)<sup>16</sup> but faces an uncertain future.

**Magnitude of Change:** Exploration success rates have declined slightly relative to the NPC Reference Case increase of 1%. Drilling efficiency has declined by 2% relative to the NPC Reference Case increase of 3% (1997 through 1999). Sensitivity analyses from the Council's 1999 Study for technology progress (Slides S13 and S14) assumed faster and slower technology changes in advancement rates (generally  $\pm 50\%$ ). In 2010, faster technology advancement in the NPC Sensitivity Case resulted in an increase in production of 600 Bcf and a reduction in gas prices to consumers of \$0.33 per MMBtu. Conversely, slower technology advancement in the NPC Sensitivity Case resulted in a decrease in production of 550 Bcf and an increase in gas prices to consumers of \$0.27 per MMBtu.

## Progress In E&P Technology



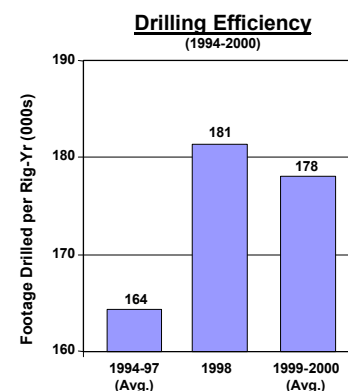
- NPC Reference Case assumes 1.5% annual improvement in exploration success.
- Imputed actual exploration success rates, 1998-2000, averaged  $-0.2\%$ .

Source: Advanced Resources Estimate.

Slide S9

## Progress In E&P Technology

### Drilling Efficiency Trend or Effect of Increased Rig Count?



- NPC Reference Case assumed 1.25% annual improvement in drilling efficiency for onshore and shallow Gulf of Mexico drilling. The deepwater improvement was assumed to be 1.5%.
- Imputed aggregated actual changes in drilling efficiency, 1998-2000, averaged  $-0.5\%$ .

Source: Advanced Resources estimate.

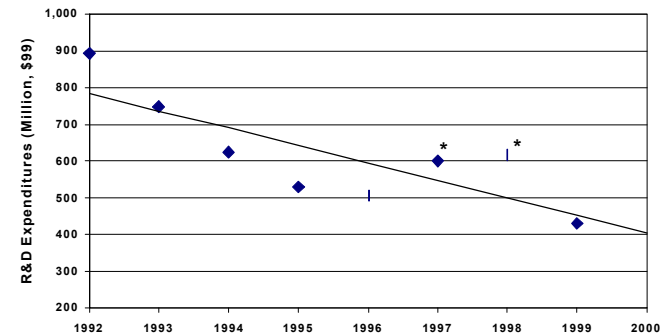
Slide S10

## Technology Progress (continued)

### Context/Observations:

- The NPC 1999 Study assumed a portion of the increased natural gas supply was based on anticipated increases in the efficiency of the drilling fleet, increases in exploration efficiency and improved reserves per well, all due to anticipated advanced in E&P technology. While the data are still preliminary, the performance of the rig fleet shows little or no gain. Are decreases in drilling efficiency transitory in nature (i.e., a function of inherent inefficiency related to a rapidly-expanded rig utilization) or are longer-term technological inefficiencies being manifested?
- Accelerated depletion poses technology and resource questions as to its root causes and how best to mitigate its effects. Progressive pursuit of more complex gas reservoirs, such as fractured formations and deep gas, will place new challenges on future exploration success rates.
- The NPC 1999 Study assumed expected technological advances based on recent levels of R&D funding and the general effectiveness of those efforts. Can reduced funding by major producers, GRI/GTI and, potentially, the DOE be borne by service companies (which operate under a “tech service” mandate), R&D consortia and technology transfer from other industries (e.g., IT, space program, tomography, laser, biotech)?

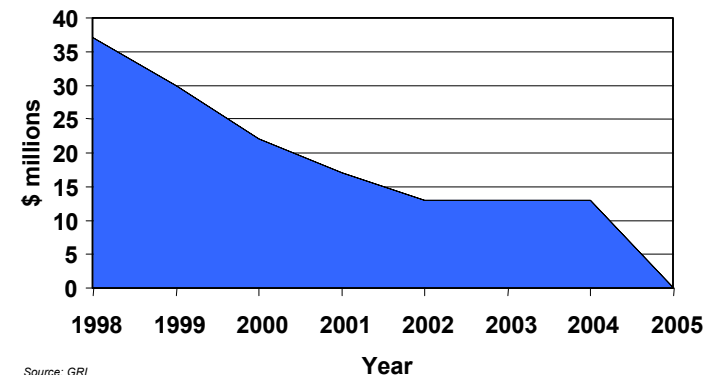
### R&D Expenditures by Producers for Oil and Gas Recovery Have Fallen by More Than 50% Since 1992



Source: EIA, Performance Profiles of Major Energy Producers, 1999.  
\*Due to more activity, additional companies added to survey of Major Energy Producers.

Slide S11

### GRI/GTI Gas Supply Research Budgets are Declining

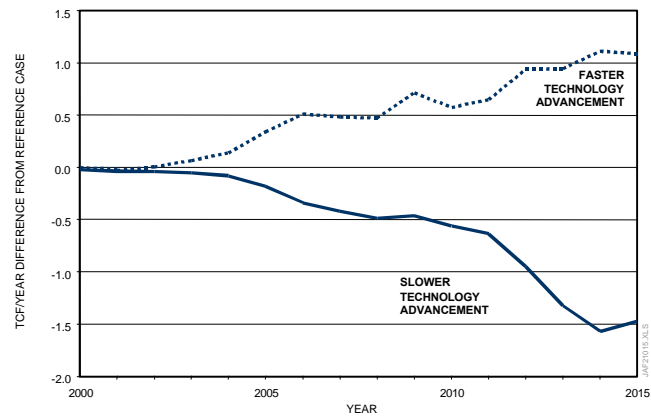


Source: GRI

Slide S12

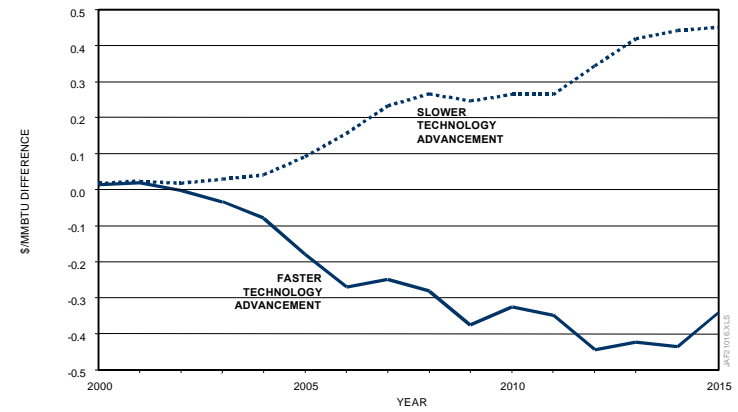
## Technology Progress (continued)

### Technology Sensitivities – Production Differences



Slide S13

### Technology Impact on Projected Henry Hub Prices



Slide S14

## Access to Resources

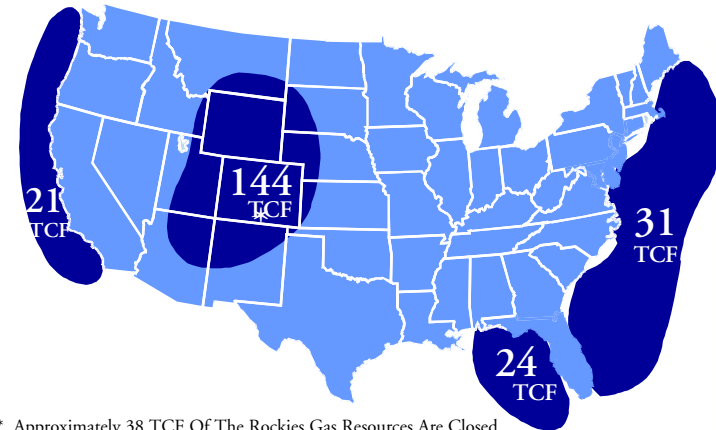
**National Petroleum Council Assumption:** All scheduled MMS lease sales (including Sale 181 in the Gulf of Mexico (GOM) would occur as scheduled in the Reference Case. All existing regulatory and restriction requirements are honored. The NPC Reference Case shows 137 Tcf restricted in the Rocky Mountains and 24 Tcf restricted in the GOM (Slide S15), the two major areas of contention.

**Market or Public Policy Change Since 1999 Study:** Forest Service “Roadless Areas” have been designated, some of which have significant resources associated with them. Lease Sale 181 is scheduled for December 2001, but opposition to the sale exists.

**Magnitude of Change:** In the Rocky Mountains, eliminating access in roadless areas would increase restricted resources by 7 Tcf and decrease accessible resources by 9.4 Tcf, by a significant 32% (Slide S16). Cancellation of Lease Sale 181 would decrease accessible resources by 9 Tcf (Slide S17). Sensitivity analyses from the Council’s 1999 Study for access (Slide S18), which assumed increased and decreased access restrictions in the Rocky Mountains, Eastern GOM and, in the Increased Access Sensitivity Case, Pacific and Atlantic development, showed  $\pm 500$  Bcf production in 2010.

**Context/Observations:** Approximately one-half of the remaining untapped natural gas resource base underlies federally owned land. In the Lower-48 states, a total of about 225 Tcf are restricted<sup>17</sup>. Excessive restrictions on development of otherwise accessible areas and marketable domestic gas supplies impairs the ability of natural gas to effectively compete for market share, especially for power and industrial sectors. Removing impediments is necessary to support National economic as well as environmental goals. Although excluded from the NPC Reference Case, the potential reserves of 2.6 Tcf in Destin Dome<sup>18</sup> in the eastern GOM continues to be blocked from development by the federal government. ANWR, included for access in the current Senate energy bill, is thought to contain about 10 BBoe<sup>19</sup> and undetermined natural gas resources, although the Fold belt and Eastern Thrust Belt plays contain an estimated 1 Tcf of resources.<sup>20</sup>

### U.S. Lower-48 Natural Gas Resources Subject to Access Restrictions



Slide S15

### Access to Rocky Mountain Resources

NPC Categorization	Pre-Roadless Areas Resource (Tcf)	Implementation of Roadless Areas Resource (Tcf)
Standard Lease Terms	7.0	-
Available With Restrictions	2.4	-
Closed to Development	1.9	11.3
Total	11.3	11.3

- **For the Rocky Mountains, based upon guidelines established in the NPC 1999 Study**
  - Implementation of the Roadless Areas will close to development an additional 9.4 Tcf of gas, raising the total to 38 Tcf from the 29 Tcf, a significant 32% increase.
  - Resources subject to access restrictions will increase by 7 Tcf (prior resource under Standard Lease Terms), from 137 to 144 Tcf.

Source: Advanced Resources estimates.

Slide S16

## Access to Resources (continued)

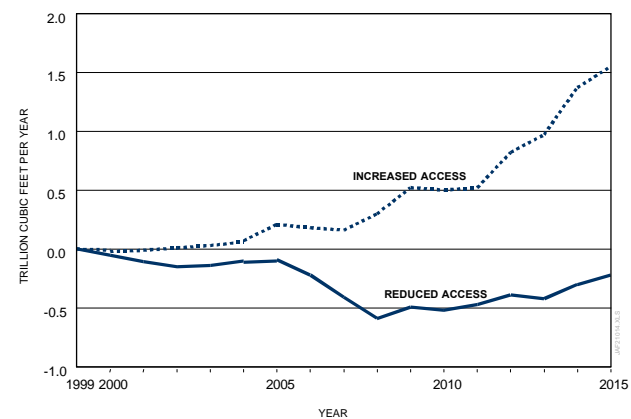
### Potential Changes in Access to Undiscovered Resources 1998-2001 (Relative to NPC Reference Case)

	Technically Recoverable Resource* (Tcf)
<b>Rocky Mountain Roadless Areas</b>	<b>(9.4)*</b>
<b>Eastern Gulf of Mexico Sale 181</b>	<b>(9.0)**</b>
<b>Total</b>	<b>(18.4)</b>

\*Advanced Resources estimates.  
\*\*NPC 1999 Study.

Slide S17

### Effect of Access Restrictions on U.S. Gas Production



Source: NPC 1999 Study

Slide S18



## Financial Requirements

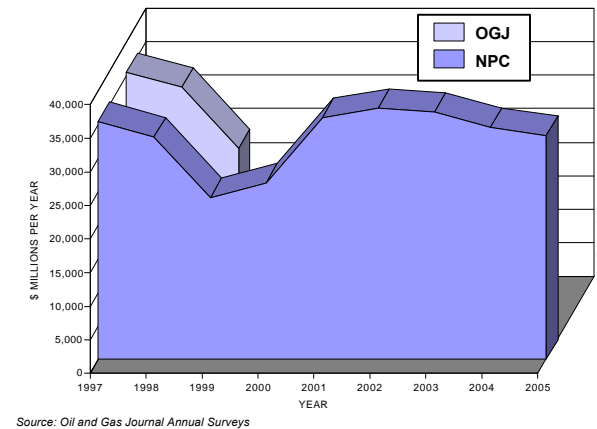
**National Petroleum Council Assumption:** The NPC 1999 Study estimated that \$33 billion and \$24 billion would be spent by the industry in 1998 and 1999 (Slide S19).

**Market or Public Policy Change Since 1999 Study:** No significant change.

**Magnitude of Change:** Industry spending in 1998 and 1999 was at levels indicated by the NPC 1999 Study. (Actual spending estimates are unavailable for 2000 at this time).

**Observations/Context:** Industry expenditures appear to be on track with levels anticipated by the NPC 199 Study. Future financial requirements for the industry are great, however, and the NPC 1999 Study indicates that a substantial increase in capital expenditures will be required. Total capital expenditures for 1999 to 2015 are expected to be \$785 billion. Companies will need to balance short-term performance demands with long-term planning to achieve needed growth. While much of the required capital will come from reinvested cash flow, capital from outside the industry will be essential to continued growth. Those outside capital requirements will need to compete with other investment opportunities, including the technology sector. Can the oil and gas industry effectively compete for necessary capital?

**Industry Financial Expenditures  
Are On Target With NPC Projections**



Slide S19

## References for the Supply Review

Information based on the NPC 1999 Study unless otherwise annotated on slides or with endnotes listed below.

1. 2000 MMS Assessment: (<http://www.gomr.mms.gov/homepg/offshore/gulfocs/95NA/95NA.html#2000>)
2. 1995 MMS Assessment: (<http://www.gomr.mms.gov/homepg/offshore/gulfocs/95NA/95NA.html#1995>)
3. USGS National Oil and Gas Assessment Project Summary
4. EIA Accelerated Depletion Study: (<http://www.eia.doe.gov/oiaf/servicerpt/depletion/index.html>)
5. Governor Knowles Office, Press Release, June 1998: (<http://www.gov.state.ak.us/press/pr061798.html>)
6. Liberty Consulting Group estimate
7. Oil and Gas Journal Article, Jan. 8, 2001
8. Alliance Pipeline press release: (<http://www.alliance-pipeline.com/>)
9. Oil and Gas Journal Article, Oct. 2, 2000
10. EIA Natural Gas Issues and Trends
11. EIA Natural Gas Issues and Trends
12. EIA Natural Gas Issues and Trends
13. EIA Country Analysis Briefs – Mexico: (<http://www.eia.doe.gov/cabs/mexico.html>)
14. EIA Natural Gas Issues and Trends
15. Gas Research Institute / Gas Technology Institute
16. U.S. Department of Energy, Office of Fossil Energy
17. Advanced Resources International estimate
18. Oil and Gas Journal Article, Dec. 7, 2000
19. Oil and Gas Journal Article, Feb. 26, 2001
20. 1995 USGS Assessment: (<http://energy.usgs.gov/factsheets/95assessment/95assessment.html>)

## DOE Workshop: Surveying the Milestones

### Transmission and Distribution Review

Kevin Petak  
Energy and Environmental  
Analysis, Inc.

EEA Inc.

2

## Pipeline Projects Completed During 1999-2000

Estimated Actual (EEA)			NPC		
Project	Date	Capacity (MMcfd)	Project	Date	Capacity (MMcfd)
Deepwater GOM Projects	99-00	1,257	Deepwater GOM Projects	99-00	830
Mexico Capacity	99-00	520	Mexico Capacity	99-00	215
Powder and Wind River Basins	99-00	275	Powder and Wind River Basins	99-00	600
TransCanada System Expn	11/99	178	TransCanada System Expn	NI	
Maritimes and Northeast	12/99	350	Maritimes and Northeast	11/00	440
Southeast Expansions	99-00	468	Southeast Expansions	99-00	400
BC Southern Crossing	12/00	250	BC Southern Crossing	NI	
Alliance	12/00	1,325	Alliance	11/00	1,325
Vector Phase 1	12/00	730	Vector Phase 1	NI	
Total of Major Projects Above		5,353	Total of Major Projects Above		3,810
Total of All Capacity Added		7,717	Total of All Capacity Added		5,254
NI = Not Included					

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## Pipeline Projects Completed During 1999-2000

- NPC assumed that over 5.2 Bcfd of new capacity would be built in 1999-2000, compared to over 7.7 Bcfd of actual additions.
  - NPC conservatively projected new pipeline capacity based mostly on economics.
- NPC did not include Vector and BC Southern Crossing, projects that were poorly defined when the NPC study commenced in early 1999.
- NPC did not explicitly include numerous smaller expansions aimed at de-bottlenecking new gas supply.

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## Locations Where Recent Basis May Justify New Gas Transmission Capability

### Observation

- Monthly basis into California from the Rockies and Canada has averaged over \$4 per MMBtu in the last 4 months
- Monthly basis from major downstream receipt points into eastern New York has spiked over \$3 per MMBtu during cold periods over the last two years
- Monthly basis from Henry Hub to Florida has increased to over 50 cents per MMBtu during summer peak
- Monthly basis between Opal and Henry Hub averages over \$1 per MMBtu during summer peak

### NPC Transmission Expansions

- No pipe or storage added before 2005
- NPC builds variants of Market Link, Eastchester, Millennium, and Cross Bay over the next five years
- NPC assumed expansions into Florida throughout the projection
- NPC assumed expansions east out of the Rockies throughout the projection

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## LNG Imports

### LNG Imports in Bcf

	NPC	Actual
1999	164	163
2000	185	224

- NPC assumed that all capacity at existing facilities would be fully utilized by 2015, with annual LNG imports of 844 Bcf. No new LNG facilities were assumed.
- Current expectations are that all existing LNG import capacity will be fully used by 2010.
- Plans have been announced for seven new LNG import facilities over the next five years, each costing roughly \$300 million.

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## Frontier Pipeline Projects

- NPC investigated three major frontier areas for natural gas:
  - Eastern Canada Offshore
  - MacKenzie Delta
  - Alaska
- NPC included flows from Eastern Canada offshore and MacKenzie Delta to the Lower-48 before 2015, but assumed that Alaskan gas would flow after 2015.

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## Eastern Canadian Offshore Gas

- NPC assumed that Maritimes and Northeast (M&N) capacity of 440 MMcfd to the Lower-48 would come on line in November 2000. NPC assumed that M&N would continue to expand up to 1.0 Bcfd by 2010 and 2.2 Bcfd by 2015.
  - M&N Phase 1 and 2 at 540 MMcfd to Canada, telescoping down to 350 MMcfd to the Lower-48 came on line in December 1999.
  - Compression could expand current M&N pipe up to 800 MMcfd in Canada by 2004.
  - Deep Panuke and 11 Sable Island satellite fields could increase gas production from Eastern Canada Offshore by 400 MMcfd by 2004.
  - Recent projections for Eastern Canada Offshore production and pipeline capacity range from 1.5 to 2.5 Bcfd by 2010. There are currently 18 fields discovered off of Newfoundland.
- Bottom Line: NPC's projection for Eastern Canadian Offshore production and pipeline may be conservative.

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## MacKenzie Delta/Alaskan Gas

- NPC assumed MacKenzie Delta capacity to the Lower-48 of 1.5 Bcfd in 2009.
  - Current pipeline planned for MacKenzie Delta includes 1,200 miles of pipe at a cost of \$3-6 billion (\$US).
  - Current expectations are that MacKenzie Delta will begin production between 2007 and 2009, reaching 1.5 Bcfd before 2010.
- NPC assumed that Alaska gas would flow to Canada/Lower-48 after 2015.
  - Alaskan producers are currently planning for Alaska gas to penetrate Canada/Lower-48 between 2007 and 2012. Most projections assume a 4 Bcfd pipe with transmission charges over \$2.00 per MMBtu (\$US) into the U.S.

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## Alaska Projects Under Review

- Alaska Highway (ANGTS) - 2,000 miles into Alberta of 3-5 Bcfd pipe at a cost of \$6-10 billion (\$US).
- Alaska North Slope to MacKenzie Delta (2 possible routes; Over the Top and Under the Top) - 1,650 miles into Alberta of 1-5 Bcfd pipe at a cost \$5-8 billion (\$US).

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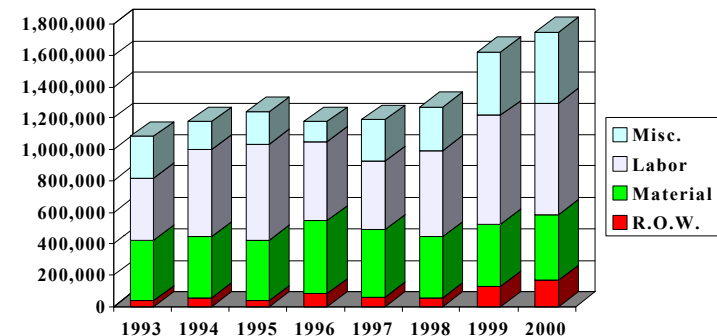
## Pipeline Costs

- NPC assumed that pipeline costs would grow by less than inflation (1.5%/year versus inflation rate of 2.5%/year).
- Driven by higher right of way costs and other factors during the last two years, nominal pipeline costs have grown at 3%/year, exceeding inflation. This growth rate is more consistent with the "High Pipeline Cost Sensitivity" run by NPC.

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## Pipeline Cost Trends (nominal \$/mile, 30 and 36 inches)



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## Compressor Cost Trends

- Compressor capacity added in 1999 was 234,000 HP, and in 2000, 254,000 HP (FERC data).
- NPC expected a 251,000 HP per year average for the U.S. between 1999 and 2004.
- Compressor costs reported to FERC in 1999 and 2000 were \$1,372 and \$1,371 per HP (nominal dollars), slightly below the cost factor applied by NPC (\$1,390 per HP in 1998\$).

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## U.S. Storage Working Gas Capacity (Bcf)

	<u>NPC</u>	<u>Est. Actual (EEA)</u>
1999	3,797	3,758
2000	3,810	3,801
2010	4,210	

- The outlook for storage working gas capacity has not changed significantly since the NPC study was completed.
- In the short term, the cost of new storage capacity has increased due to higher cost of base gas.
- As gas costs decline, the expected cost of storage capacity will return to levels projected in the NPC study.

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## Recent Activity Regarding New Pipeline Services

- A number of pipelines have made proposals to offer new services aimed principally at power generation markets.
  - hourly firm transportation service
  - electronic nomination and scheduling
  - seasonal and monthly differentiation of long-term contract MDQ
- Existing shippers have expressed concerns that new tariff services and capacity contracted to new customers could degrade the quality of existing services.
  - reduced delivery pressure
  - reduced hourly flexibility
  - more operational flow orders

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## Recent Activity regarding New Pipeline Services (continued)

- FERC continues to reject negotiated terms and conditions of service.
- Order 637 required the reporting of additional data to improve market transparency and improve the efficient use of existing tariff services.
- FERC continues monitor the evolution of gas and electric markets to determine whether its regulation fulfills statutory the statutory requirements.
  - affiliate behavior
  - California market
- FERC has received petitions to restrain gas prices and the market value of gas transportation capacity.

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## Pipeline Access to Right of Way

- Excepting the roadless policy in U.S. Forest Service lands, there has been no significant change in policies that affect pipeline access to land needed to expand capacity.
- Interventions and protests filed by land owners and environmental groups are a continuing concern for regulators.
- However, FERC rejected a petition to withdraw the Certificate of Public Convenience and Necessity for Market Link filed by land owners and New Jersey.

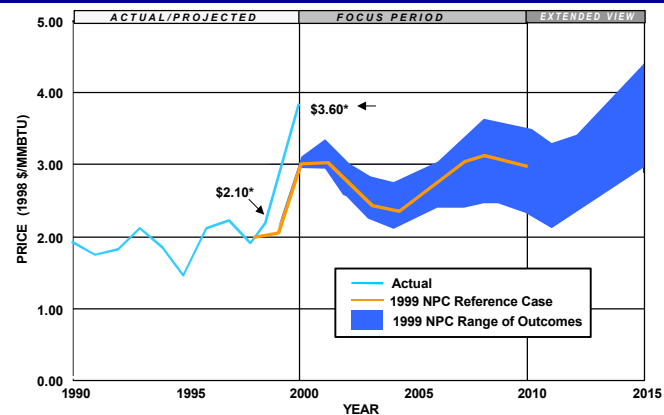
EEA Inc.

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## Natural Gas Prices

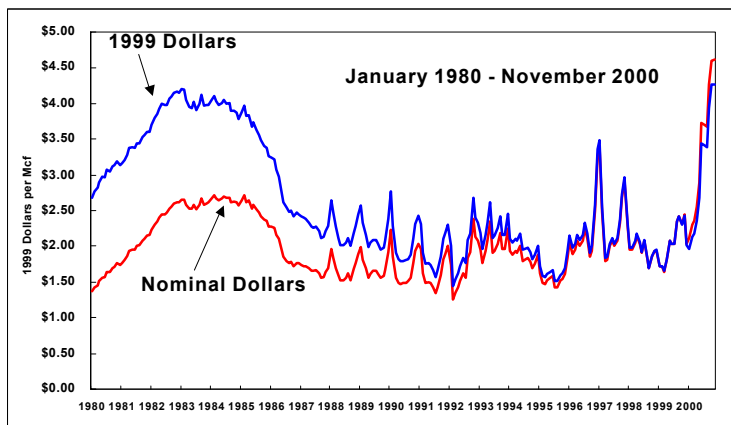
By  
James Kendell  
Energy Information Administration

### Historical and Projected U.S. Natural Gas Prices Lower-48 Weighted Average Wellhead Price

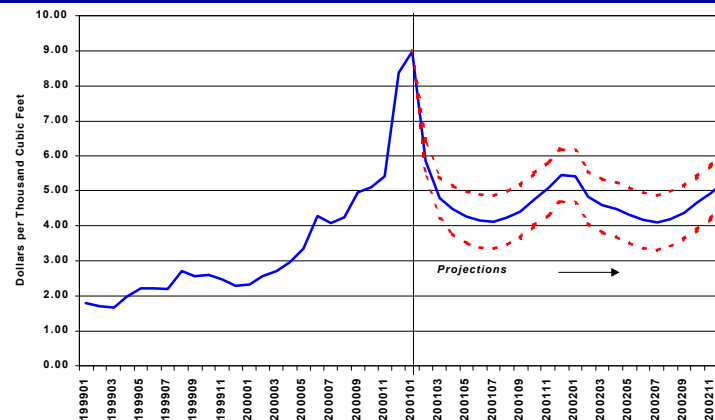


Prices are NOT intended to be a forecast. Seasonal factors such as abnormal weather and demand fluctuation have not been taken into account.  
\*Estimated Source: EIA Natural Gas Monthly, Jan 2001.

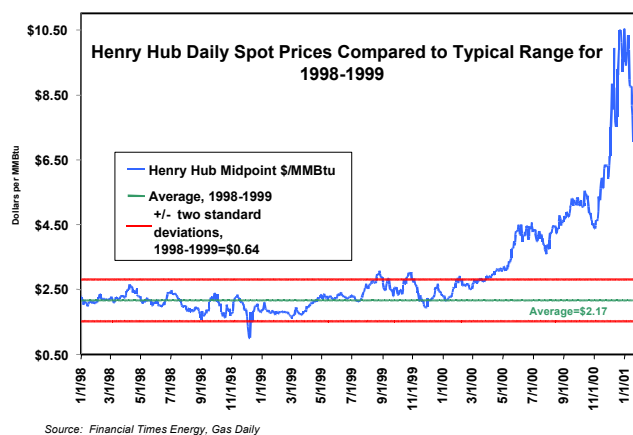
### Average Wellhead Prices Currently Exceed the Highest Level Over the Past 20 Years



### Natural Gas Spot Prices: Base Case and 95% Confidence Interval



### Current Natural Gas Spot Prices: Well Above the Recent Price Range



### Questions

- Will these high prices and/or price volatility affect future demands for natural gas, particularly from electric generators?
- What do we do about all those angry people whose gas bills doubled this winter?
- In the face of such high gas prices, why didn't gas production bounce back more quickly?
- Have the high gas prices changed the industry's price expectations for project development purposes?
- Have the prices made it any easier to raise capital?